E. M. Baker

The Monthly Review of the AMERICAN ELECTROPLATERS' SOCIETY

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JULY 1941

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DR. GLASSTONE TO CONTRIBUTE REVIEW ARTICLES

We are pleased to announce to our readers that Dr. Samuel Glasstone of Princeton University will write a series of articles on electroplating for the MONTHLY REVIEW beginning with the August issue.

Dr. Samuel Glasstone is one of the world's most distinguished electrochemists. He was born in London, England, educated at the University of London. He spent four years after his schooling in various chemical industries before returning to teach physical chemistry at the University of London. He later taught at the University College of the Southwest (England) and at the University of Sheffield, England. In March 1939, he left England to take up permanent residence in the United States.

At present, he is Research Associate in Chemistry at Princeton University and Scientific Editor of Princeton University Press. His researches are many and have dealt mainly with electrochemical problems. His work on complex ions is particularly valuable. He has published some ninety papers in various scientific journals and is author of several well-known textbooks, including "The Electrochemistry of Solutions" and "Electrolytic Oxidation and Reduction." One of his most recent works is "Text-Book of Physical Chemistry," a comprehensive text of over 1200 pages, discussing almost all phases of the subject. Dr. Glasstone's introductory article follows.

PRINCIPLES OF ELECTROCHEMISTRY AND ELECTRODEPOSITION

INTRODUCTION

SAMUEL GLASSTONE, Ph. D., D. Sc.
Frick Chemical Laboratory, Princeton, N. J.

Electroplating is in many ways an art, much depending on the skill of the individual plater in matters that are intangible. It is nevertheless also true that the procedures employed in the electrodeposition of metals have a definite scientific basis of chemistry, physics and physical chemistry. The members of the American Electroplaters' Society are highly skilled in the art of plating, and many are also interested in knowing as much as possible concerning the theoretical foundations of their work. There is little doubt that an appreciation of the fundamental principles of electrodeposition will prove to be not merely of general interest to the plater, but will sooner or later find some definite practical applications. It is for this reason that I am glad to respond to the invitation that has been extended to me to contribute a regular series of monthly articles to the REVIEW. In these articles I shall endeavor to discuss some of the principles

of electrochemistry that are particularly applicable to electrodeposition.

It is always difficult in a series of this kind, intended for readers of different types, to know where to begin; the obvious answer to this problem is "begin at the beginning!" That is what I propose to do, although I realize that many members of the Society will be very familiar with what I shall be telling them in the earlier articles. Will those members please bear with me for the sake of the others? I propose, therefore, to say something first about atoms and ions, and then to go on to talk about electrolytes and ionization. This will lead to a consideration of the simple phenomena of electrolysis and a brief discussion of Faraday's laws. I then hope to deal with the electrical conductance of solutions and the transference of ions. Later we shall go on to consider neutralization, the hydrolysis of salts, buffer action, pH, and related topics. The whole subject of electrode potentials will have to be gone into next, and this will lead to a treatment of polarization in general, and of such special topics as cathode films, diffusion, overvoltage and passivity. Finally we will have something to say concerning the condition which influence the form of electrodeposited metals, the effect of addition agents, throwing power, and so on.

My intention is that each month's contribution should be quite short, say about two pages or so of the REVIEW. If you see an article of six or seven pages in length, you will probably say "that looks interesting, I'll read that when I get some free time," but, what with one thing and another, the opportunity never seems to come around. With an article of two pages, however, you will be able to say "I'll read that right now!" That is at least what I hope you will do.

If these articles are to fulfill the purpose for which they are intended, it is essential that there should be some sort of collaboration between us. I would like to know what your reactions are to the proposals I have outlined, and also what you feel about the various articles as they appear. I would like to know whether I am dealing with the subjects in which you are interested and whether the method of treatment is satisfactory. Of course, it is inevitable that there should be some difference of opinion, but I should like to hear from you so that I can get some idea of your various points of view. I am hoping in due course to have a "Question and Answer" section in which points treated in earlier articles can be amplified if you should so desire it. Will you therefore please write to me giving your opinion of this venture and offering any suggestions or criticism which you think will be helpful? Please, also, don't hesitate to ask questions. I shall not be able to answer them individually, but I shall try to deal, either in the regular articles, or in a special section with such points as appear to be of general interest.

Dr. Blum's Address *to the* Boston Convention

DR. WILLIAM BLUM
(National Bureau of Standards, Washington, D. C.)

FROM certain reports, I thought that the Electroplaters' Society, or at least the plating industry, was nearly dead and that it was about time to conduct a funeral service. Your presence here, (at the Convention) the large attendance and the deep interest are evidences that the plating industry is very much alive. I have full confidence that it is going to stay alive in spite of the rather gloomy statements that were made this morning by Dr. Stratton.

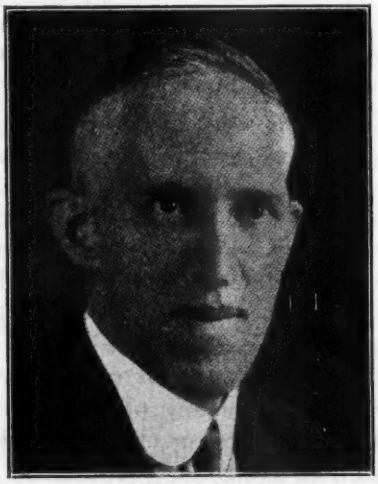
I am very glad that he was able to be here to speak to you officially and to give you the point of view which must determine the policy of the OPM. He apologized to me in advance because he felt badly about coming with any such message as he had to give to you this morning. He also stated frankly that he did not know anything about electroplating and had never been in an electroplating plant in his life. I am therefore put in the position of trying to suggest what the plating industry can do about the situation. Dr. Stratton really gave the clue when he said that to stay in this or any other business, a firm must either obtain defense contracts or must find substitutes for the materials that are not available.

In discussing this subject, I will speak particularly from the standpoint of the government, because, as interested as I am in the Electroplaters' Society, I am working for the government, and trying to advise and assist on its numerous problems. We have not only the branch of the government that you heard from this morning, but also all those other branches of the government that are seeking to meet defense needs.

The term, "defense needs" is rather vague and covers a great deal more than simply guns and planes and battleships, as essential as they are. It is not possible to have one million or more men in arms without having all the equipment with which to live. They must have pots and pans for cooking, knives and

forks and spoons; they must have garbage cans! Those things are just as much a part of the defense project as are the obviously military devices. In addition, there are a great many activities, like defense housing, that make it possible for people to work in the factories, which will require materials, such as hardware and plumbing fixtures, to make those dwellings habitable. The picture is not as dark as it might at first seem to the electroplating industry.

There will be innumerable applications of electroplating that will be absolutely essential to the conduct of this program by the government. It is not possible for anyone, either in the



DR. WILLIAM BLUM

position of Dr. Stratton, or familiar with the plating industry as I am, to attempt to predict in advance just what these applications will be. I believe you should go back to your plants and your firms with the idea of finding something that is needed by the government that involves and requires the use of plating. To the extent that those conditions are met, you need not worry about the continuation of plating.

In the present emergency, the very shortage of materials such as aluminum and brass and stainless steel will require that, at least for defense purposes, substitutes must be found for those metals; and many of the substitutes that will be found will re-

quire plating. One of the questions that was asked this morning was about the availability of steel. Of course, if there are no steel or copper or brass or zinc base die castings to be plated, then you need not worry about anything with which to plate them. We can feel confident that certainly first, for defense purposes and secondarily for civilian needs, other metals, particularly steel, will be used. This steel will have to be plated, and consequently in many cases more plating will be done or required. Just to cite a single instance, I know that careful consideration is being given to the substitution of steel cooking utensils plated with nickel and chromium for the aluminum pots and pans that have been used by the Army and Navy. I am not prepared to say how well they will meet the requirements under the severe conditions of camp life, but I want you to recognize that this is the sort of thing that the plating industry should be alive and on its toes to meet. While I am not prepared to give you a purely optimistic picture, I do not quite share the pessimistic picture that you might have gathered from the remarks of Dr. Stratton this morning.

Those of you who are old enough — George Hogaboom and I are among those who remember the conditions twenty-four years ago — know that there was lots of plating done for the government during the last war, and that plating will take all kinds of turns and applications which you will never think of or anticipate in advance. Just at the end of Dr. Stratton's remarks, I was called out for a long distance call from the War Department in Washington asking me to go to a particular plant where there was trouble with some plating being done for them. George again smiles because that is what we had him doing, he was a trouble-shooter twenty-three years ago. Plating is essential, and it is merely necessary to find out where and how you can get into that kind of work.

The situation on nickel plating is particularly acute and therefore the industry has naturally given a great deal of thought and study to what it can do in the way of substitutions for nickel in plating. In normal production the automobile industry used over 60% of the nickel anodes, and in turn the nickel anodes constituted normally 7% of the total production of metal. During the last couple of months the quota for nickel anodes has been cut to about 50% of its normal amount, and consequently it

was necessary for the automobile industry, as well as all the other users of nickel anodes, to reduce their consumption of nickel.

In getting along with that curtailed supply of nickel, I urge very strongly that the plating industry should not simply spread the same amount of nickel over a larger area without attempting to compensate for it. The plating industry must give very careful consideration at this time to maintaining standards of quality of plating, even in these difficult conditions. If you put out poor, inferior plating, you are playing into the hands of those other industries, such as the plastic, paint and enamel industries, which are having a great opportunity today to compete with plating, because of the difficulty of getting metals. Far better that you do half as much plating and do it well, than simply to do a large amount and do it so poorly that people will thank their lucky stars that they can buy plastics or something else instead of plating.

If we are to keep up the quality, we must find substitutes. In the automotive industry and in general plating on steel, the obvious course is to increase the proportion of copper, that is, to substitute copper for a part of the nickel. The exposure tests that were conducted with your organization in recent years have shown that in thin coatings, copper does not have a protective value equivalent to that of nickel. Therefore, if in thin coatings, you cut down the proportion of nickel and increase that of copper, it is necessary to use more copper than you save nickel. That relation is not necessarily true in thicker coatings, those of the order of 0.001", particularly if the copper is buffed. We do not have exact data, but the indications are that for coatings of 0.001" or more, that is, the higher grades that have been adopted in the specifications, the copper can be substituted for nickel nearly pound for pound or inch for inch without any serious decrease in quality.

On the other hand, there is a lower limit to the thickness of nickel that can be put on over the copper and still get a satisfactory coating. Even though you may have protected the steel against corrosion, it is necessary to have a moderate thickness of nickel in order to protect against the copper tarnish which will come out through any pores in the nickel. Without attempting to fix an exact value, I would say that certainly not

less than 0.0001" and preferably 0.0002" of nickel should be used, no matter how much you substitute copper for nickel. There is no use putting on such a thin coating of nickel that it does not serve any useful purpose.

It does not sound encouraging when you hear that copper is being put on the Priorities List, but in this whole picture we must maintain a sense of proportion. These metals may all be scarce, but not equally scarce. If, for example, there is potentially much more copper than nickel, and if the plating is justified, you can get copper more readily than you can nickel, at least to substitute for part of the nickel.

The question is often raised of the substitution of cadmium for zinc. Zinc is scarce and Dr. Stratton said this morning that zinc is just now being put on Priorities. Some people say, "Well, if we cannot get zinc for plating, we will use cadmium." I was told by one of the OPM officials that the defense needs for cadmium are double the present production of cadmium. At present about 50% of all the cadmium that is produced is going into plating and there is no obvious way of increasing the production. So do not fool yourself and feel that you can substitute cadmium for zinc in plating. Of course, if you have the cadmium, thank your lucky stars and use it, but in those cases where somebody may have unusual stocks, the cadmium will be a good deal scarcer than the zinc.

The problem is exactly the same as if there was an attempt to substitute cobalt for nickel. It was shown over twenty-five years ago by Kalmus, Harper and Savell that cobalt plating can be done satisfactorily, but cobalt is much scarcer than nickel and the demand for cobalt is relatively just as great as that for nickel.

I suggest that you keep in mind the possibility of substituting lead plating for certain applications and not simply for those purely military applications where it may be particularly valuable. In general, when lead coatings meet the requirements, lead plating is the logical procedure, because in hot-dipping with lead, you must use some tin, in the so-called terne plate. If tin becomes scarcer it will be on the priorities list.

In nickel plating, substitution of insoluble anodes is being tried. The use of insoluble anodes, for example, of lead, is

likely to oxidize most of the brighteners used in bright nickel, so that, while it may be possible to operate a semi-bright nickel solution with insoluble anodes, it is at least doubtful whether the present bright nickel solutions can be operated with insoluble anodes.

When using insoluble anodes, where will the nickel come from? Of course, you say, from nickel salts. Today these are produced almost entirely as by-products from copper refining. The total supply of nickel salts, as far as we have been able to learn, is equivalent to from one to two percent of the total available production of nickel. This is equal to about one-fourth of the normal amount of nickel anodes used, or perhaps as much as a half of the nickel anodes that are now permitted to be used.

To the question of what becomes of the nickel salts, the answer is very simple, you throw it all down the sewer in the dragout. Every pound of nickel sulphate that you buy and use in normal nickel plating goes down the sewer. The only way you can increase the supply is to save the dragout, for example, to reduce it by appropriate standing rinse tanks. You cannot replace the deposited nickel directly with nickel sulphate. You must replace it with a basic material like nickel carbonate in order to neutralize the acid that is set free when insoluble anodes are used. Fortunately, nickel carbonate can be produced more cheaply per pound of nickel than nickel sulphate, because from the purified nickel solution, the nickel carbonate can be precipitated and sold in the wet form more cheaply than crystals of nickel sulphate can be produced. It is possible for a certain proportion of nickel plating to be done from nickel salts, provided you will reduce the waste of nickel salts in the dragout, and will add nickel carbonate to replenish the nickel that is deposited by the use of insoluble anodes.

If there is more extensive deposition of copper from cyanide solutions, the first question is the availability of cyanides. Approximately 10% of the total production of cyanide goes into the plating industry. One of the companies that has not heretofore produced the white cyanide suitable for plating has just started its production. The chances are there will be no actual shortage of cyanide, although there may be at particular times difficulty in getting deliveries on it.

Another material that many of you use in the copper baths is Rochelle salt that has heretofore come from France, where it is produced from the "tartar" in the residues from the wine barrels. Because we do not have much trade with France these days, Rochelle salt has become very scarce. I have not been able to find out whether any serious efforts are being made to recover the cream of tartar from the wine industry in California. Some effort is being made to substitute citrate for the tartrate in copper cyanide baths. I do not know how well the citrate will work. If the Rochelle salt had never been used and someone would ask whether it would be better to use tartrate or citrate, you might as well toss up a penny, as to predict whether tartrate or citrate would be preferable in a cyanide bath.

The chromium ores are mostly imported, but on the other hand the grade of chromium ore that is used for manufacturing chromic acid and chromates is a lower grade and at present is not competing with the grade of chromium ore used for making ferro alloys. As long as we can continue to import the chromium ores, there is not likely to be a shortage of chromic acid.

MR. LIONEL CINAMON (New York Branch): I merely wish to supplement Dr. Blum's statement. Most of the nickel salts produced today have been produced from scrap nickel, and nickel plated articles, and not so much as a by-product of copper refining. In addition to that, most of the nickel salts are used for the hydrogenation of fats. That complicates the problem of nickel salts, so there is not as much nickel salts as Dr. Blum optimistically stated.

DR. WILLIAM BLUM: I should have called attention to the fact that of the total amount of nickel salts, at least 50% is used in hydrogenation of fats and oils, so that the plating industry may have nickel salts equivalent to only 0.5% of the total supply of nickel.

MR. B. G. DAW (St. Louis Branch): I was just wondering what type of lead solution Dr. Blum would recommend for this emergency.

DR. WILLIAM BLUM: Our only actual experience with lead plating has been with the lead fluoborate solution. We have done very little on that since we worked with it over twenty years ago, in connection with the plating of gas shells.

We have no reason to doubt that it is still a good solution, and in fact, we do not know of any solution that would likely be superior to the fluoborate.

MR. WILLIAM H. HARNEY (Boston Branch): I was wondering, Dr. Blum, what of the possibility of chrome plating over heavy copper plate, eliminating the nickel altogether?

DR. WILLIAM BLUM: That question has been raised a number of times. From the experiments that were made on the direct deposition of chromium on copper and brass, the results showed that there was a marked tendency toward corrosion and flaking of the chromium. At least under severe conditions of corrosion, it looks as if some nickel coating, for example at least 0.0001″, should be applied before the chromium. There may be cases in which direct chrome plating may be justified. For example, some steel trays plated directly with chromium are being tried out by the War Department because it is largely a matter of wear and abrasion.

MR. HARNEY: Is there any battery or electrolytic action between the copper and the chromium?

DR. WILLIAM BLUM: Chromium in all these cases acts as a noble metal, and will tend to accelerate the corrosion of any other metal under it. Because nickel itself is also passive, the chromium will not accelerate the corrosion of nickel, but it will accelerate the corrosion of copper or brass.

MR. FRANK J. HANLON (Chicago Branch): Can you furnish any information relative to the fluoborate of lead solution, and the improvements that have been made in the uses and solubility of casein glue?

DR. WILLIAM BLUM: I am sorry that I cannot give any first-hand up-to-date information on lead plating. I have heard of a few plants that have been experimenting lately with lead plating and I will be glad to hear the results of their experiments. We used ordinary glue; as to whether other addition agents might be preferable to the glue, I am not able to say.

CHAIRMAN COSTIGAN: Any further discussion?

MR. CHESTER W. SMITH (Grand Rapids, Michigan): We have been doing some preliminary work, Dr. Blum, in the use of sodium citrate and I might state at this time that it is very encouraging. We feel that it can be used in a similar manner as

Rochelle salts and in approximately the same concentration. I don't have our complete work with me at this time; however, it is being forwarded, since there were some last minute changes in order to complete it. It is possible this may be published soon. It covers the efficiency range for the use of sodium citrate, the effect upon the cathode deposit as well as upon the anode behavior.

I might mention one point that has been brought out which is particularly significant. Although sodium citrate does not give the same cathode efficiency as Rochelle salts in approximately the same concentrations, the efficiency is increased to approximately the same degree as in the case of Rochelle salts, when the potassium ion concentration is raised to a similar value. This notation would lead us to believe that the potassium present in Rochelle salts is a contributing factor to the increased efficiency encountered in the Rochelle salt bath.

I have one other comment which pertains to conservation of nickel; we have been working with a private research organization on a recovery process for nickel. This is somewhat different from any other efforts that I know of in the recovery of nickel. We can recover almost 100% of the nickel that is lost in the dragout rinse. Our only difficulty has been to date in recovering this, in sufficient purity without any loss of the dragout solution.

However, the purity of the nickel has been increased from 92½% to 95%. Our work is continuing on this along commercial lines with a view of developing and installing it in such a manner that it can be efficiently recovered without any undue labor and possibly make it fully automatic, so that there will be no possibility of other fluctuating elements creeping in. This may prove the answer to our nickel losses. As Dr. Blum has stated, nickel salts all go down the sewer. If we can recover all the nickel salts that will be lost in the dragout and use insoluble anodes, we certainly will be able to plate a whole lot longer with nickel.

DR. WILLIAM BLUM: I would like to comment on, first, the remarks on the use of citrate and call attention to the fact that citrate is a product of the citrous industry. With California and Florida producing lots of lemons and grapefruit, we need never fear any shortage of citric acid in this country.

MR. CARL HEUSSNER (Detroit Branch): I just wanted

to make one statement that is somewhat contrary to what Dr. Blum just said. I do not believe you can buy citric acid. I do not believe you can change your tanks from Rochelle salt to sodium citrate in a year, at least, from the story of the chemical companies. So I am wondering if we are not stepping into something that is quite academic, at the moment, at least, and not very much help from the standpoint of giving us any actual relief at the present time.

DR. WILLIAM BLUM: I am glad to have that comment. I know that some people are trying citric acids and citrates, and I know that the price of these quoted today is much lower than that of tartrates. But if you cannot get the citrate, it does not make much difference what the price is.

MR. BERT SAGE (Boston Branch): I know we are in a mess at this time on nickel. One thing that interests me a whole lot is current distribution and stopping off the backs of material not necessary to be plated. On some of these darned screwy things we are getting into our plating rooms today, we are sometimes wasting four-fifths of the nickel. That comes down to the question of shielding and of auxiliary anodes. I feel sure from what work I have done up to this time that a lot can be done on auxiliary anodes to shield nickel deposition. I am sure that after we have got through this crisis, nickel plating will be much better off through the use of methods of distributing currents than it is today.

MR. GEORGE B. HOGABOOM (Matawan, New Jersey): I would like to have Dr. Blum tell us what he means by insoluble anodes — what material?

DR. WILLIAM BLUM: The ones which have been tried out and which seem most promising under favorable conditions are lead anodes. Practically no insoluble anode can be used in a nickel solution if the chloride content is very high, but when the chloride content is as low as it is feasible (of course, you ordinarily add chloride to corrode the nickel anode) you can use lead anodes with very little attack of the lead. It may well be that just as in the case of chrome plating, some alloy of lead may prove to be superior to pure lead, although I do not know of any experiments on that.

MR. HARRY MISNER (Cincinnati, Ohio): I have tried plating chromium over copper but it has been my experience

that in a short time the copper shows through. One of our branches has a welding torch on exhibit. It is plated directly over brass with chromium for twenty-five minutes. The gentleman who is in charge of this exhibit told me this torch will hold up for several years.

It has been my personal experience that chromium applied direct on brass is not durable nor is it satisfactory for any length of time. I have used this method of plating only where economy was of primary importance.

I have discussed this matter many times with men at this convention, and elsewhere, — some of whom have devoted almost their entire lives to electroplating — and the consensus of opinion is that this direct method of plating chromium is entirely unsatisfactory from the standpoint of durability and that whenever they have tried it, many of the jobs have come back for replating.

I personally believe that the only real satisfactory method is to plate with nickel first. It may be that due to the shortage of nickel at this time we may have to resort to this direct plating method.

I wish all of you who are interested would look at the work out there. While it looks very good, time alone will tell, and it seems to me that there is much room for discussion on this subject.

MR. ARTHUR LOGOZZO (Pittsfield, Massachusetts): I would like to ask you to elaborate somewhat on the thickness of chromium on those steel trays you mentioned, and also to make some recommendations as to the thickness of chrome directly over steel to be used for gadgets and fixtures that will be outside.

DR. WILLIAM BLUM: I am unable to do either . . . The first case involved some experimental trays that were plated and tried out. How thick the chromium was or how good the trays will be, I am not able to say. I feel certain that for general use in outdoor exposure, plating of chromium directly on steel will prove impracticable. If you are prepared to put on as much as 0.001″ of chrome, — in other words, as much chrome as you would nickel, it is possible you might get fair protection against corrosion. With coatings up to 0.0002″ di-

rectly on steel, the porosity of chromium is such that you get corrosion under outdoor conditions of exposure.

MR. W. J. SCHNEIDER (New York, N. Y.): I want to inquire from Dr. Blum whether any thought has been given to a metal that is so plentiful that they have been looking for a place to use it, that could be substituted as an undercoating for some of the subsequent coatings they speak of, that is, silver.

DR. WILLIAM BLUM: There has been a good deal of interest in late years in the efforts to increase the use of silver. Silver is relatively plentiful in the sense that it is available, but it is still a relatively expensive metal. The work that was done by the silver producers showed that there was very little advantage, from the standpoint of corrosion, in substituting silver for nickel. It takes almost as much silver as nickel to provide equal protection against corrosion of steel. Silver itself has the disadvantage of tarnishing even more than nickel, so that it might be necessary to chromium plate over the silver. While it is possible to chromium plate over silver, it is more difficult than over nickel. We should encourage the use of silver, particularly on food utensils or containers where the cost of the silver might be warranted. The total amount of silver that is available would represent a substitute for an appreciable portion of the nickel that was formerly available for plating.

In speaking of rarer metals, I say not too facetiously, that one metal we have lots of is gold. I am quite serious when I say that more consideration might well be given to the use of gold for commercial coatings, particularly if chromium should get scarce, because the gold is one of the few metals that has as good tarnish resistance as chromium. I am not saying that we should plate bumper bars with gold, but simply that we should give more consideration to the use of gold.

I want to conclude this discussion by saying that while the plating industry may have great difficulty in meeting these unusual emergency conditions, I feel sure that they will meet them. They may, through facing these conditions, actually so improve the processes of plating that many of the changes now made as emergency measures will persist afterwards. If you will forgive the pun (I was not aware when I first said it that it was a pun) it is going to put the plating industry on its mettle!

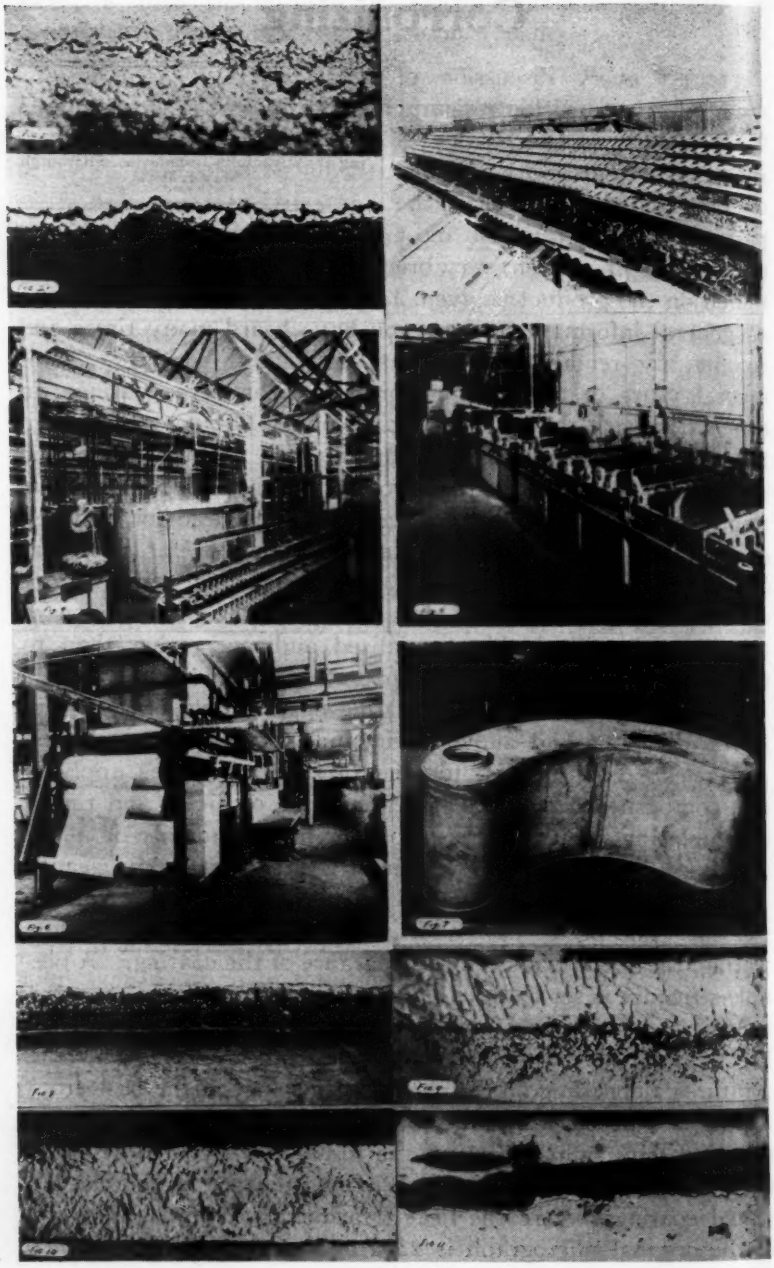
Corronizing

Read by
R. RIMBACH
of Standard Steel Spring Co. at the Meeting of Galvanizers Committee, Pittsburgh, May 1, 1941

ALMOST every discussion of a new corrosion resistant coating or corrosion resistant alloy starts with a theory of corrosion which will place the particular product in the most favorable light. Then, very briefly at the end, the real data obtained on the product is given. I will omit from this discussion all general information which you have heard many times and confine my remarks to data on corronized coatings. After several years of research on corrosion protective coatings, in connection with the company's automobile bumper production, the Standard Steel Spring Company has developed metallic coatings with extraordinary corrosion resistant properties. The results obtained were so remarkable and the need for reducing consumption of strategic materials, required for National Defense, was so great that Mr. Enos, the president of the Standard Steel Spring Company, has permitted the presentation of this paper to this highly specialized audience rather than to withhold this information until patents were granted.

Corronizing is a coating consisting of a number of very thin layers of metals and alloys having unusual corrosion resisting properties. The process, for the present, comprises applying thin composite coatings of nickel and zinc or nickel and tin by electroplating. Either ferrous or non-ferrous metals or alloys can be corronized. The base metal is first thoroughly cleaned in an alkaline cleaner to remove grease and dirt, and preferably pickled. The better the condition of the metal surface before plating, the better will be the appearance of the coating. A possible sequence is set forth in Table 1.

After the nickel and zinc (or nickel and tin) coatings have been plated, the coatings are heated for varying times and temperatures, depending on the thickness or gauge of the base stock and the conditions which the coatings must meet. For this discussion I will confine my remarks to the nickel-zinc Corronized coatings. Fig. 1 shows the nickel-zinc interface of the electroplated coatings before the heat treatment. The magnification in the original micrograph is 250x and the sample was etched



in a mixture of chromic acid and sodium sulphate. Fig. 2 shows the various layers formed by a heat treatment at 675°F. for 6 hours. Magnification and etching solutions are the same. A nickel layer remains which is shown at the top. The dove-gray layer is the beta phase (47 to 52% nickel), the dark layer the gamma prime phase, the gray layer the gamma phase (15% nickel) and in this sample some free zinc remains.

X-ray methods of identifying the phases in the corronized coatings were inapplicable. For their identification, the solution potentials of fused alloys of nickel and zinc of known composition were compared with the potentials of the alloys in the coatings. For this identification, a method involving the anodic dissolution of the coating was applied. The method is that of anodic dissolution by a constant impressed current, the time required for the dissolution of each phase being proportional to the thickness of that phase.

Test Results

Wire, strip and sheet protected by a Corronized coating have not as yet been in service sufficiently long to give the complete history of service life; however, the condition of test samples up to the present confirms the anticipated advantages. Samples have been mounted on test racks located alongside the A.S.T.M. racks at Brunot's Island. (Fig. 3). Table 2 shows the coating thickness of these various samples and time to failure when exposed to the weather. The chart gives a relation of corrosion resistance of coatings of nickel, zinc and Corronized to coating thickness. This chart shows the initial failure in salt spray. Table 4 gives a comparison of various weights of galvanized coatings with Corronized on sheet and wire and initial failure in salt spray. The last column in this table gives the saving in zinc, if Corronized coatings are substituted for galvanized.

Applications

A number of actual applications of the Corronized coatings are now in production. *Thermostats* — The Robertshaw Thermostat Company is coating copper tube oven thermostats. Fig. 4 is the Robertshaw Corronizing Division. This shows the thermostats mounted on a rack before passing to the cleaning operation. *Outboard Motor Parts* — a corronizing installation for coating

many outboard motor parts has been made at the Evinrude Plant of the Outboard, Marine & Mfg. Company. Corronizing is replacing other metallic coatings on the products of this company. Fig. 5 shows this installation. *Fly Screen* — One of the most successful applications of the Corronized coating was developed in conjunction with the Technical Laboratories of Sears, Roebuck and Co., and Corronized screen is being produced by the Hanover Wire Cloth Company and is on sale in the retail stores of Sears, Roebuck and Co. At present, four million square feet of fly screen is produced per month. This installation is shown in Fig. 6. Several other pictures and a complete description of the operation was recently described in *Iron Age*, a reprint of which will be forwarded on request. Since this article was written, however, the heat treatment is now carried out by passing the screen between internally gas-heated rolls. *Insecticide Sprayer Tanks* — Fig. 7 shows one of the first applications of the corronized coatings on sheet steels. Many thousands of these tanks were sold during the summer of 1940. These tanks were fabricated by soldering. This year, the fabrication cost on many thousands more has been reduced by welding.

Many other applications have been investigated. Pump rods have been Corronized and tested under all kinds of conditions. Metal stampings and formed parts have been tested and Corronizing such fabricated parts in electroplating departments without the addition of any equipment has been started.

Oil Cans — A sample of an oil can body, which was put through a can machine by the Continental Can Company, shows a light-colored streak at the seam where it was evidently abraded by the can-making machinery. Tests on such a can body were made, however, by an independent laboratory which determined the coating thicknesses as .000096″ of nickel and .000259″ of zinc. Salt spray tests were made which showed initial failure of 1230 hours on the seam and 1262 hours away from the seam.

Wire — Recently very extensive tests have been carried out by the Sears Laboratories, in conjunction with our Research Laboratory, to determine the possible application of Corronized wire to welded fence construction. Our laboratory received samples of three different lots of #14 gauge galvanized wire, illustrated in the following micrographs, all having a magnification of 1000x and etched in 0.5% Nital for five seconds. Fig. 8

shows a hot-dipped coating with a thickness of 560 millionths of an inch of zinc, Fig. 9 a hot-dipped coating with 1750 millionths, Fig. 10 an electrogalvanized coating of 1180 millionths. Fig. 11 shows the Corronized coating prepared in our laboratory on a single strand line. This coating has a thickness of 340 millionths. Samples of all wires were welded by the Research Department of the Taylor-Winfield Corporation. Welded specimens, straight control specimens and bent specimens of each wire were placed in atmospheric corrosion, salt spray corrosion and humidity tests. The time has been too short for failures to have occurred in the atmosphere but the results of the salt spray and humidity are available. The laboratory reports "Corronized wire when welded and twisted will resist corrosion equally as well as the better grades of galvanized fence wire." The results of the tests are shown in Table 4. Corronized wire samples were twisted and then tested in salt spray.

Advantages of the Corronized Coating as Compared with Hot-Dipped Galvanizing

1. The coating is very uniform in thickness — there are no "drip edges."
2. The thickness of the coating can be accurately controlled.
3. Does not affect physical properties of the base stock.
4. The coating is very ductile and adheres perfectly so that it will neither peel, crack nor flake when bent around a diameter equal to the thickness of sheet or when wrapped around its own diameter in the case of wire.
5. Coating surface is smooth, compact and can be made semi-bright on wire.
6. Initial failure does not progress as fast with the Corronized coating as it does with other coatings. In case of galvanized material, the complete failure of the sample occurs shortly after the initial failure, whereas in the Corronized coating, it has been found that in many cases the coating has self-healing features after an initial failure has occurred.

(Some of the advantages mentioned above, of course, apply to electrogalvanizing as well as to Corronizing.)

Costs

Up to the present, electrogalvanized coatings comparable in thickness and corrosion life could not compete in cost with hot-dipped coatings. For heavier coatings, of course, electrogalvanized does not have to compete with hot-dipped since electrogalvanizing has this field to itself. Present indications are that the cost of applying the corronized coatings, due to the fact that thinner coatings have Corrosion resistance equal to much heavier galvanized coatings, will be equal to or less than hot-dipped coatings.

The cost will obviously vary with the equipment installed, the wire or strip gauge, the thickness of deposit and the power cost.

A very recent development of the corronized coating permits the production of a bright coating. The appearance of this coating as it leaves the Corronizing line is a silvery lustrous finish. It is easily as bright as the wiped hot galvanized wire and is of a much more lasting nature. It will not darken as quickly as the latter when exposed to the atmosphere.

TABLE I

Sequence of Operations in Corronizing

1. Cathodic Cleaning
   Cleaner: Soda Ash 3-5 oz./gal.
   Sodium Hydroxide: .4-.8 oz./gal.
   pH: 12.6-13.2
   Current Density: 20-60 amps./sq. ft.
   Operating Temperature: 180°F.
2. Rinsing
3. Pickling (Used only when samples are rusted or scaly)
   Pickle: Sulphuric Acid (55-57°Be′) 3% by vol.
   Operating Temperature: 160°F.
4. Rinsing
5. Anodic Pickling
   Pickle: Sulphuric Acid (55-57°Be′)
   Current Density: 80-200 amps./sq. ft.
   Operating Temperature: 160°-180°F.
6. Rinsing
7. Nickel Plating
   Solution: Nickel Sulphate: 28-35 oz./gal.
   Nickel Chloride: 4-6 oz./gal.
   Boric Acid: 4-5 oz./gal.
   pH: 2.0-5.0
   Current Density: up to 400 amps./sq. ft.
   Operating Temperature: 120°-125°F.
8. Rinsing
9. Zinc Plating
   Solution: Zinc Sulphate: 35 oz./gal.
   Ammonium Chloride: 2 oz./gal.
   Aluminum Sulphate: 2 oz./gal.
   pH: 3.5-4.0
   Current Density: up to 300 amps./sq. ft.
   Operating Temperature: Room
10. Rinsing
11. Drying
12. Heat Treating
    Temperature: 500°-750°F.
    Time: up to 6 hours

TABLE II

Atmospheric Test on Electrogalvanized and Corronized

	Coating Thickness in Millionths Inch	*Initial Failure in Months*
Electrogalvanized	150	3
	200	4
	275	O.K. at 5 Mos.
	350	O.K. at 5 Mos.
Corronized	120	O.K. at 5 Mos.
	143	O.K. at 5 Mos.
	225	O.K. at 5 Mos.
	320	O.K. at 5 Mos.

TABLE III

Comparison of Galvanizing and Corronizing on #22 Gauge Sheet Steel

	Thickness Millionths of an Inch	*Hours to Initial Failure in Salt Spray*	*Saving in Zinc*
Galvanizing 0.7 oz./sq. ft.	600 Zinc	60	
Galvanizing 1.25 oz./sq. ft.	1100 Zinc	200	
Galvanizing 2.5 oz./sq. ft.	2200 Zinc	500	
Corronizing	25 Nickel — 75 Zinc	60	Approx. 7/8
Corronizing	60 Nickel — 130 Zinc	300	Approx. 7/8
Corronizing	90 Nickel — 130 Zinc	500	Approx. 15/16

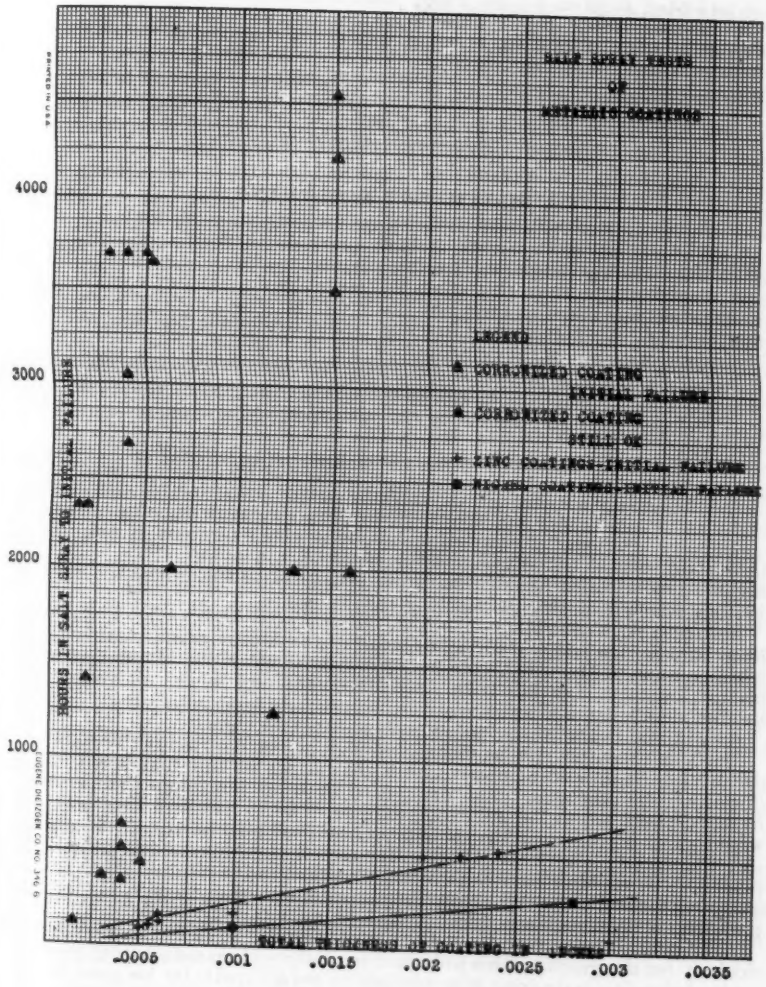
Comparison of Galvanizing and Corronizing on #9 Wire

	Thickness Millionths of an Inch	*Hours to Initial Failure in Salt Spray*	*Saving in Zinc*
Galvanizing .345 oz./sq. ft.	580 Zinc	70	
Galvanizing .500 oz./sq. ft.	850 Zinc	120	
Galvanizing 1.25 oz./sq. ft.	2000 Zinc	240	
Corronizing	100 Nickel — 100 Zinc	140	Approx. 7/8

TABLE IV

Accelerated Corrosion Tests on Welded Galvanized and Corronized Wire

Coating	Thickness in Millionths of an Inch	Initial Failure of Straight Wires in Salt Spray (4 wires in each set)	Initial Failure of Welded Wires in Salt Spray (3 wires in each set)			Initial Failure of Welded Wires in Humidity (3 wires in each set)		
			Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN machine	*Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN machine*	*Welded on a Taylor-Winfield 20 KVA, Type W machine*	*Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN machine*	*Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN machine*	*Welded on a Taylor-Winfield 20 KVA, Type W machine*
Hot-dip Gal'z'd.	560	4 in 120 hr.	1 in 48 hr. 2 in 120 hr.	3 in 120 hr.	2 in 72 hr. 1 in 120 hr.	2 in 96 hr. 1 in 168 hr.	2 in 96 hr. 1 in 120 hr.	3 in 96 hr.
Hot-dip Gal'z'd.	1750	4 in 288 hr.	1 in 120 hr. 2 O.K. 264 hr.	1 in 72 hr. 2 in 120 hr.	1 in 72 hr. 2 in 120 hr.	3 O.K. 264 hr.	1 in 120 hr. 2 in 144 hr.	1 in 96 hr. 2 in 120 hr.
Electro-Gal'z'd.	1180	3 O.K. 288 hr. 1 in 288 hr.	1 in 144 hr. 2 in 216 hr.	1 in 72 hr. 2 in 216 hr.	2 in 72 hr. 1 in 264 hr.	2 in 126 hr. 1 in 264 hr.	1 in 120 hr. 2 in 192 hr.	2 in 120 hr. 1 O.K. 264 hr.
Corronized	340	2 in 288 hr. 2 O.K. 288 hr.	3 O.K. 264 hr.	3 O.K. 264 hr.	1 in 264 hr. 2 O.K. 264 hr.	2 in 216 hr. 1 O.K. 264 hr.	1 in 168 hr 2 in 192 hr.	3 in 168 hr.



SALT SPRAY TESTS OF METALLIC COATINGS

PROCTOR MEMORIAL AWARD

Dear Mr. Proctor:

I have just been advised by Mr. W. J. R. Kennedy, Executive Secretary of the American Electroplaters' Society, that my paper presented at the Boston Convention was awarded the Proctor Memorial Award, in memory of the late Mrs. Proctor, by the Paper Awards Committee.

It is needless to say that I am very grateful for receiving this Award, made possible by you. Please accept my sincere thanks for same.

M. M. Beckwith,
Industrial Chemical Research.

A SILVER "W" FOR "VAN"

(From the Mansfield (Ohio) News Journal, June 26, 1941)

From the hands of George H. Bucher, president of Westinghouse Electric and Manufacturing company, C. L. Van Derau, works manager of the Mansfield plant, today received the "silver W" medal for outstanding service. The presentation was made at the plant this morning. Also present at the ceremony were A. W. Robertson, Pittsburgh, chairman of the board, and B. W. Clark, vice president of the company.

The medal, made of bronze with a silver "W" on its face, bears the legend "whom his fellow men delight to honor." Since 1933, when the award idea was developed, only 180 persons in the vast Westinghouse organization have received it.

With the medal was a certificate, citing Van Derau as follows: "Particularly for the quality of his judgment in matters of manufacturing methods; for his ingenuity in devising new ways to reduce costs; for his good humor under all circumstances; and for his part in effecting Westinghouse-Mansfield community relations." Van Derau has been works manager of the Mansfield plant, one of the largest making electrical appliances, since 1935. He became general superintendent in 1931. He came to the Mansfield plant in 1922 as manager of the plating department.

Born on a farm near Marysville, Van Derau, who is 49, got a job in a plating plant at 14. He was a recognized authority on finishing and plating metal when he came to Mansfield. He is a former president of the Mansfield Chamber of Commerce and has been active in community affairs for years. He has five daughters, and two sons.

An editorial in the News Journal says of Mr. Van Derau:

"He's an executive, yet he looks as though he could go out in the plant and do any job there is to be done—and he has a lock of hair that keeps falling down over his forehead. You don't need to know him more than an hour to feel entirely natural in addressing him as "Van." His eyebrows probably would go up if you put a Mr. on in front and used his full name. That's the sort Clarence L. VanDerau, Works Manager of the Mansfield Westinghouse plant, is. It couldn't have been better told than in the citation given to him along with the "silver W" he received yesterday from George H. Bucher, president of Westinghouse Electric and Manufacturing company.

"The citation was given for a number of reasons—to quote its words 'particularly for the quality of his judgment in matters of manufacturing method; for his ingenuity in devising new methods to reduce costs; for his good humor under all circumstances; and for his part in effecting Westinghouse-Mansfield community relations.' "

"All who know C. L. VanDerau—pardon, we mean Van—will be glad that he has received the Westinghouse silver "W" and will be certain that he richly deserves it. But if he reads this he'll probably mutter "Whaddye want to make all that fuss for?" That's the kind of a fellow he is—as it says on the silver W—one 'whom his fellow men delight to honor.' "

The Removal *of* Chromium Contamination *From* Alkaline Plating Solutions

DR. M. M. BECKWITH
The J. B. Ford Sales Company
Wyandotte, Mich.

(This article won the $100 Proctor Memorial Award.)

THE trend of recent years to electrodeposit metal as a bright lustrous deposit has caused the plater to become aware of the effect of small amounts of impurities in the plating solution. By now everyone is aware of the difficulty encountered when small amounts of a great number of impurities are found in a bright nickel plating solution. With increased efficiency of deposition and with increased speed of production, the effect of these impurities has become more pronounced.

In the case of bright nickel plating solutions, methods for the removal of these impurities have been found and applied commercially with a great deal of success. Much has been said or written with regard to the removal of impurities from nickel plating solutions. Under the present economic conditions, copper plating is becoming more important than it has been in recent years. Copper is commercially plated from either the cyanide solution or the acid solution. If copper is plated from an acid solution, it is usually preceded by a cyanide copper strike. Many installations which were previously plating nickel directly onto steel are now being forced to plate copper on the steel first and follow this with nickel.

In the automotive trade, the specifications may call for a total of .001″ plate, of which half may be copper and half nickel.

More efficient copper plating solutions have been developed during recent years, which can be used to obtain the required thickness of copper in a reasonable length of time. With the increased stress on production, the impurities causing trouble in copper plating solutions are becoming more important.

One of the impurities in copper plating solutions that causes considerable trouble is the presence of chromium in the hexavalent state; in other words, present in a cyanide copper plating solution as sodium chromate. Wagner and Beckwith have

shown that hexavalent chromium present in a copper cyanide plating solution in the amount of .075 grams per liter will reduce the efficiency of the cathode to less than 2%. The curve showing the effect of chromium, as determined by Wagner and

DR. M. M. BECKWITH

Beckwith,* is shown in Figure 1. The analysis of the bath is as follows:

Copper Cyanide	6 oz./gal.
Free Sodium Cyanide	.75 oz./gal.
Sodium Carbonate	6 oz./gal.
Rochelle Salt	3 oz./gal.
Temperature,	115°F.
Current Density	30 amps. per square foot.

*Wagner and Beckwith, Trans. Amer. Elect. Society, June 1938

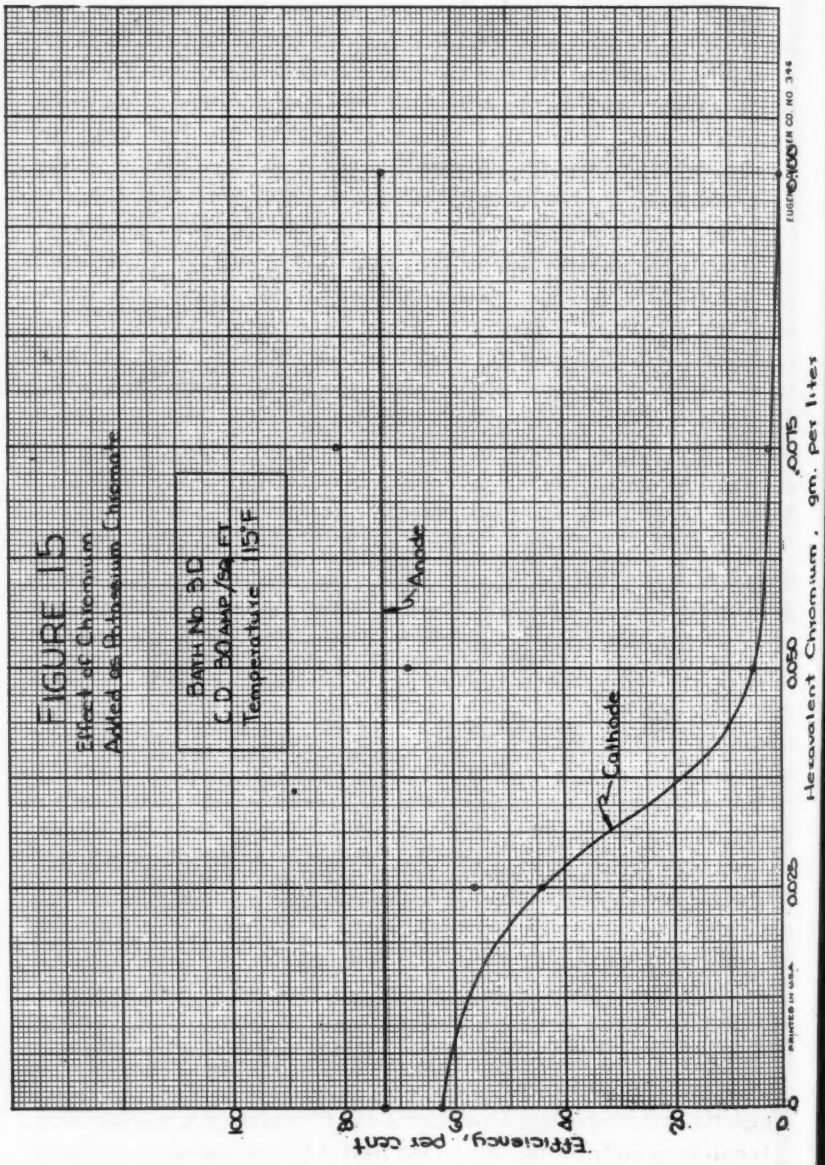
At the time that this detrimental effect of chromium was discovered, no method was found to remove the chromium or even to nullify its effect. It was thought for some time that the only effect of chromium was to reduce the efficiency of deposition from cyanide plating solutions. However, within the last year, it was found that if chromium were present in a copper cyanide strike, before a subsequent copper plating solution, that blistering would occur between the heavy copper deposit and the copper strike. If the entire plating line consisted of bright nickel and chromium directly after the heavy copper deposit, then even small quantities of chromium would produce a dulling of the luster of the subsequent deposit after the copper strike. It has been found that these troubles proceed in a definite order, with increasing amount of chromium contamination. First, a dulling of the deposit of nickel and chrome, then the appearance of streaks, then some blisters along the streaks, and finally poor adherence over the entire piece.

Now, in the case where only a single layer of copper is being deposited from a Rochelle salt cyanide plating solution, blistering does not occur at as low a concentration of chromium as is found when a strike solution is used followed by a heavy deposit solution.

In the search for a material to reduce the chromium and eliminate its harmful effect, many things were tried, and sodium hydrosulfite was found to be effective. The material is commonly called sodium hydrosulfite, but strictly speaking, chemically, the name should be sodium hyposulfite. Either name is found in chemical handbooks. Do not confuse this chemical with photographic hypo, which is sodium thiosulfate, because it will not reduce chromium. In order not to be confused, the formula for sodium hydrosulfite should be remembered. It is $Na_4S_2O_2$. One trade name for the material is "Lycopon." This material will reduce hexavalent chromium, and in the reduced state chromium is not harmful. The possible equation for this reduction is given as follows:

$$2Na_2CrO_4+3Na_2S_2O_4+2NaOH+2H_2O \rightarrow 6Na_2SO_3+2Cr(OH)_3$$

It can be seen from this equation that 2.6 times as much sodium hydrosulfite will be required as there is present chromium, figured chromic acid, CrO_3. If the chromium present be figured as hexavalent chromium, it can be seen that 5 times as much



Sodium hydrosulfite will be required as there is present hexavalent chromium.

This equation shows that sodium hydrosulfite will reduce

chromates to chromic salts. If the cyanide plating solution does not contain Rochelle salts, chromium will be reduced to the trivalent state and will be precipitated out of the bath as chromic hydroxide.

However, if Rochelle salts are present in the bath in any appreciable quantity, the chromium will be reduced apparently to the trivalent state, where it is tied up as a complex with the tartrate of the Rochelle salts. It has been found by experience that under some conditions, the chromium will not be precipitated from the solution in the presence of Rochelle salt. However, even though it is not precipitated, it has no harmful effect on the cathode deposit when in the reduced state.

Considering first the case where no Rochelle salts are present, the bath can be treated with sodium hydrosulfite and the precipitated chromium hydroxide can be filtered out. Under these circumstances, the bath is as good as new. If there are Rochelle salts present, periodic treatment may be required to maintain the chromium in the reduced state. The periodic addition of sodium hydrosulfite is required because during electrolysis the excess sodium hydrosulfite will be oxidized at the anode, and after this has happened the complex chromium tartrate radical is apparently oxidized, giving back hexavalent chromium.

In the case where lead is present in the copper cyanide plating solution as a brightener, excess quantities of sodium hydrosulfite over and above that required to reduce the chromium will reduce the lead and precipitate it out as a black precipitate. This black precipitate may be the sulphide.

Sodium hydrosulfite is a strong reducing agent in neutral or alkaline solutions. In such solutions it is relatively stable over long periods of time. However, in acid solutions it is immediately decomposed, giving off SO_2 gas. In the case of an alkaline cyanide plating solution giving difficulty due to the presence of chromium, sodium hydrosulfite added to that solution in the quantity of .05 to .075 grams per liter will return the solution to normal plating conditions. Reference to Figure 1 will show that only small amounts of chromium will produce considerable difficulty, and that under those circumstances only small amounts of sodium hydrosulfite will be necessary to correct the trouble.

It has been found by commercial applications and alo by experimental tests that larger quantities of sodium hydrosulfite do

no harm at the cathode. Quantities up to ½ gram per liter have been used commercially and up to 8 grams per liter have been used in experimental tests. If the solution contains no Rochelle salts, quantities of sodium hydrosulfite above ½ gram per liter cause polarization at the anode. In the presence of Rochelle salts this does not occur.

Under circumstances where chromium can be removed as the hydroxide and filtered from the solution, it is recommended that an excess of sodium hydrosulfite be used and after the chromium has been filtered out, the excess hydrosulfite be destroyed with hydrogen peroxide. Hydrogen peroxide will oxidize sodium hydrosulfite to sodium sulfate, and the excess hydrogen peroxide added to the solution will be decomposed by the temperature of operation of the cyanide plating solution. It is well to note that iron may be present in copper plating solutions that have been used in an iron tank. This iron is present as sodium ferrocyanide. This chemical will give a straw-colored solution and that color is bleached out by the addition of sodium hydrosulfite. Peculiarly enough, that color is not returned to the solution when the solution is electrolyzed for long periods of time. It has been found that the bad effects of sodium ferrocyanide at the anode can be overcome by the addition of small quantities of sodium hydrosulfite.

Sodium hydrosulfite can be used for the removal of chromium from zinc cyanide plating solutions and also from cadmium cyanide plating solutions. In either of these two cases, it is well to add the minimum quantity of sodium hydrosulfite to accomplish the removal of the chromium.

In general, when using this material it is well to bear in mind the fact that inorganic compounds of sulphur, like sodium hydrosulfite, or photographic hypo, $Na_2S_2O_3$, or any other similar material, may under the proper conditions, be reduced to sulphide, and as such may give difficulty at either anode or cathode.

The proper and careful use of sodium hydrosulfite should prove beneficial in any plating line where chromium contamination in cyanide plating solutions is causing trouble. If strict analysis of the solution for chromium content is not possible, then sodium hydrosulfite can be added to reduce the yellow color of the solution caused by chromium. As this color returns, due to additional chromium contamination or oxidation of the chromium

proceeds, then more material can be added to maintain the solution as of the "bleached" condition. This method of control has proved satisfactory.

One other visual method of control at the plating tank is the amount of current required to cover the piece being copper plated, or the time required to cover it with a specific fixed current density. If either the current must be increased or the time increased to produce coverage, and it is known that chromium is present in the solution, then sufficient hydrosulfite can be added to reduce the chromium and return the solution to its original plating condition as to time or current density. As that time or current density is increased, due to the presence of chromium, up to a certain specified predetermined figure, or set of conditions, more hydrosulfite can be added to return the solution to a normal operating condition. This method has also proved satisfactory.

Conclusions

1. Hexavalent chromium is reduced to the trivalent state in alkaline solutions by sodium hydrosulfite, and as such has no effect at the cathode in cyanide plating solutions.

2. The reaction product of sodium hydrosulfite is first, sodium sulfite. This material in small quantities is not harmful in a cyanide plating solution. The final oxidation product is sodium sulfate, since sodium sulfite can be oxidized either to sulfate at the anode, or by oxygen of the air.

3. The amount of sodium hydrosulfite required to overcome the bad effects of chromium contamination in cyanide plating solutions, can be determined either by analysis, by visual observation of the color of the solution, or by the increase of the time required for coverage, or the current density required for the coverage of the piece by the metal being deposited from the alkaline cyanide plating solution.

4. Quantities of sodium hydrosulfite in considerable excess over that required to reduce the chromium apparently have no harmful effect at the cathode, and within reasonable limits, have no effect at the anode.

(The author wishes to express his appreciation to Mr. R. M. Wagner, Mr. D. M. Overcash, and Mr. M. R. Caldwell for their assistance in making possible commercial practical tests of this method of removal of chromium from cyanide plating solutions.)

Gold Plating Cigarette *and* Vanity Cases

By WILLIAM BRUHNS

Presented at Newark Branch Meeting, May 16, 1941

IN gold plating vanity and cigarette cases, various gold solutions are being used. These consist mainly of alloy solutions such as red gold, green gold, pink gold, and yellow gold.

Inasmuch as these items are generally classified as novelties, their finish is of primary importance. These gold deposits are fairly heavy and wear resisting. However, they do not possess the wear resisting quality of the Bek process of gold plating in which an alloy gold deposit is subjected to a heat treatment and a diffusion of the base metal and the gold deposit takes place, which assures not only wear resistance, but also perfect adhesion. Alloy gold deposits are generally preferred because of their decorative value as well as the fact that they are generally harder than a pure gold deposit.

It is quite apparent to the average plater that a number of well-known factors directly and indirectly contribute to the successful conclusion of a finished article. The aim of the man in charge of the finishing operation is consequently to obtain uniform dense, fine grained gold deposits at a minimum of cost, as well as a beautiful and protective deposit that is readily marketable. In order to obtain generally satisfactory gold deposits, certain factors which are in direct relationship to one another, namely temperature and current density as well as the chemical composition of the bath must be carefully controlled.

The cleaning of the work, agitation and wiring or racking of the work are also of primary importance. If trouble is encountered in gold plating, temperature may well be considered a contributing factor. Many conditional changes are noticeable due to a variation of temperature. These are principally a change of the grain structure of the deposit, with a consequent change in color.

At a low temperature (80° to 120°F.) and a current density of from 3 to 6 Amps. per square foot, a light yellow deposit is obtained, whereas at a temperature of 120° to 200°F. with a cor-

responding increase in current density a heavy dark deposit is obtained. If however, the bath is worked at room temperature, it is advisable to use agitation of some form to prevent cathode polarization. This is caused by the fact that the immediate cathode area is quickly depleted of the metal, and is not being replenished rapidly enough due to the density of the solution at that temperature.

The increase in current density has an effect similar to the increase in temperature in a cyanide gold solution inasmuch as there is a change in the crystal structure, at an elevated current density range. The crystal structure becomes finer and consequently, closer grained and darker colored gold deposits will be obtained. Too high a current density as well as too high a temperature will prevent the metal from being deposited evenly, over a large surface, which may be caused by one or more of several conditions. At a high current density, hydrogen gas is liberated too rapidly, the excessive gasses form a film, which will prevent the passage of the metal to be deposited.

When the metal is being too rapidly depleted in the cathode area, an excessive amount of other chemical components is present. This unbalanced condition of the bath in the cathode area may be responsible for a film of solid or liquid which in turn may cause poor deposits. The aforedescribed conditions are generally termed cathode polarization. However, most of these harmful conditions can be minimized, if not completely avoided, by agitating the bath, because agitation will help considerably in bringing about a more equal distribution of metallic ions in the bath, as well as help to decrease the formation of gas in the cathode area.

It is a known fact that in a cyanide gold solution the heavier metallic ions are found on the bottom of the tank. This improper distribution of metal in the bath is a direct cause of poor conductivity because of the lack of metallic particles in the high and central sections of the bath, the flow of the current across the bath is greatly reduced. It is therefore desirable to create a condition where a more equal distribution of metal and the various chemical components is obtained.

Uniformity of color in gold plating is of course one of the most important considerations of gold plating. It is for this reason that not too much emphasis can be placed on wiring or racking

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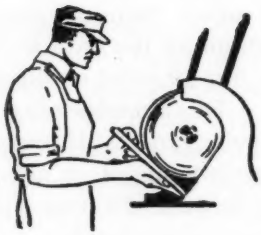

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of the work. The overlapping of the work or wires, or the mounting of work on a rack in such a manner as to permit one piece to be closer to the anode than the other will cause shading; and consequently a variation of colors will result. The chemical composition of a gold solution is a factor which must be carefully controlled at regular intervals, particularly free cyanide and metal content which tend to have a direct bearing on the color of the deposit. Cyanide decomposes very quickly because of its reaction with various other chemicals present in the bath, as well as through high current density and high temperature. The metal concentration of the bath is very important in so far as it affects the uniformity of the color of the deposit.

At a low metal concentration, using a medium current density range the color is very light. When the current density is increased the work will become dark and uneven in color, because the electric currents will seek the least resisting point, namely the edges; and a heavy dark uneven deposit will result. If the metallic concentration in the bath is higher, it is quite possible to use a higher C. D. Range, if darker gold colors are desired, without fear of dark and burnt deposits on the edges; however at a medium C. D. Range the deposits remain fairly light in color, as well as bright.

Any intermediate plate such as nickel, copper and brass, or the color of the base metal itself if no intermediate plate is used will affect the color of the gold deposit, particularly in flash deposits.

A salt water gold solution has been used advantageously on various types of vanity and cigarette cases. It has several distinct advantages: it is simple to operate, and the deposit is very uniform in color, even on a large flat surface and can be operated at a very low cost. The deposit is fine grained and dense and therefore quite protective. The current is generated through electrolytic contact of two dissimilar metals. The C. D. in salt water gold bath is quite low (about L V). It is self regulating and depends on the amount of work which is suspended from the cathode, increasing with every piece of work added. This assures a uniform C. D. at all times.

The equipment used for a salt water gold unity consists of a copper tank, with a sheet of zinc placed inside of the copper tank, separated by insulators. The cathode or work bar must

be fastened to the zinc. The porous pot, containing the gold solution is placed inside the sheet of zinc. Care must be taken to provide the proper heating facilities, since this bath is operated at a temperature of about 150°F. A sodium chloride solution is used in the copper tank; however, ammonium chloride may also be used. Wood or cast iron tanks have been used in place of the copper tanks. However, copper tanks are in more general use for this type of bath. The following formula has been successfully used in salt water gilding.

Water	1 Gallon
16 oz.	yellow prussiate of potash
8 oz.	sodium carbonate
2 oz.	sodium sulphite
3 dwt.	gold as fulminate

Two and three tone gold finishes have become a popular addition to our already large number of finishes in the compact and cigarette case line. Red, green and yellow gold are the most popular combination as well as red and yellow gold on sterling silver.

The cases in which these multi-colored gold finishes are deposited are generally engine turned with more or less straight line designs of various descriptions The panels which are being plated are protected by a stencil, while the remaining area is being sprayed through this stencil with a stop-off enamel. Then the pieces are baked for about 15 minutes. Inasmuch as it is not always possible to build a stencil tight enough to entirely eliminate a fine spray on the panel which is to be plated, we found it to be good practice to give the case a light color after the enamel is baked, to assure a cleaner and oxide free surface. The cleaning of the cases prior to gold plating is very important in this respect, that extreme care must be taken that the stop off enamel is not lifted on any part of the case. The cleaner used for the purpose is mild cleaner, at about 4 oz. per gallon concentration.

A short soaking period or a few seconds of direct current are generally sufficient. The temperature of the cleaner is kept low, about 80° to 120°F. Occassionally when an excessive amount of polishing compounds is on the work it was found necessary to swab the work in order to obtain a chemically clean surface. On this particular type of work it is advisable

to maintain all the plating solutions at a temperature no higher than 80°F. High temperature in the bath and excessive gassing of the work while in the bath will of course greatly increase the danger of the stop off material being lifted. Cool or gold cleaning is also a necessary feature in the sequence of operations on three tone gold finishing. A cool potash solution with or without current has been used successfully. For cold cleaning (room temp.) good results have been obtained by swabbing the work with a saturated solution of sodium bicarbonate and alcohol. Following this operation a thorough water rinse is necessary, after which a cyanide dip and another water rinse are generally sufficient preparation prior to plating.

FROM THE OFFICE OF PRODUCTION MANAGEMENT

Three fourths or more of the aluminum kitchenware housewives donate to the national defense program can go into defense manufacture. Robert E. McConnell, chief of the Conservation Division, Office of Production Management, made this estimate, based on Great Britain's experience in collecting aluminum scrap. F. H. La Guardia, Director, Office of Civilian Defense, has asked all governors, mayors, and defense councils to set up committees to collect any used aluminumware housewives can spare without replacement. Collections will be made in a house-to-house canvass, during the period July 21-30, in which the American Legion, the Boy Scouts of America, and many other organizations will participate.

British collections of similar household aluminum scrap resulted in up to 95 percent of the aluminum contained therein being used in defense manufacture. Mr. McConnell estimated that the American scrap would be found to run somewhat lower in content of aluminum usuable for defense, but estimated that it might reach the figure of 82 percent.

Aluminum technical experts in OPM said they expected two main classes of aluminum would be turned in by housewives: (1) Wrought aluminumware, made from sheet aluminum, mostly of a "3S" alloy, containing 1¼ percent manganese, with some of "2S" alloy—pure commercial aluminum. (2) Cast aluminumware, consisting mostly of an alloy containing 5 percent silicon, but with some other alloys occuring.

When the aluminum donated by housewives reaches the smelters, the wrought aluminum ware will be separated from the cast aluminum ware and the two types will be melted down separately. After the aluminum is melted down, it is analyzed to see just what quality it is. It will be up to the Army and Navy to say (through specifications for defense orders) just what portions of these ingots can be used for specific defense items, but OPM aluminum experts said that in their opinion it could be used for Aircraft construction, Shell fuse parts, Bomb fuse parts, Battleship parts, Tank parts, Portable military equipment parts, Equipment carried by the individual soldier.

Just what aluminum would be used in what item of defense manufacture would depend upon the quality of any particular ingot and the specifications of the Army and Navy. Some portions of the aluminum donated, after the melting, probably would be of a quality unusuable for defense equipment, but that the total of such metal would not at most exceed 25 percent, Mr. Mc Connell said. Housewives were urged not to donate their used aluminumware before July 21, and to help set up local committees to supervise collection under instructions Director La Guardia has sent to Governors and Mayors.

ELECTROCHEMICAL SOCIETY CONVENTION AT CHICAGO

Gentlemen:

At a recent meeting of the Board of Directors of this Society the writer was asked to extend to the American Electroplaters' Society a most cordial invitation to participate actively in the forthcoming convention of our Society at Chicago.

The main feature of the Chicago Convention will be several sessions devoted to Modern Electroplating. The papers submitted at these sessions will be separately published together with the discussions in a volume entitled Modern Electroplating. Subscriptions have already been received for several hundred copies at a special pre-publication price of $4.50.

Looking forward to the pleasure of greeting a large contingent of your membership at Chicago and assuring you of our sincere appreciation of your cooperation.

Colin G. Fink,
Secretary, The Electrochemical Society, Inc.

Members of the American Electroplaters' Society are invited and urged to attend the fall convention this year of the Electrochemical Society. Authors of the papers to be presented are outstanding authorities in their respective plating fields who have been kind enough to expend a great deal of time and effort, especially valuable in these trying times, to their preparation. Following is the tentative list of subjects and authors.

1. GENERAL PRINCIPLES AND METHODS OF ELECTROPLATING—Wm. Blum, A. O. Beckman, Walter Meyer
2. BRASS—H. P. Coats
3. CADMIUM—L. R. Westbrook, K. G. Soderberg
4. CHROMIUM—G. Dubpernell
5. COBALT—K. G. Soderberg, W. L. Pinner, E. M. Baker
6. ACID COPPER—J. H. Winkler
7. NICKEL—K. G. Soderberg, W. L. Pinner, E. M. Baker
8. CYANIDE & ROCHELLE COPPER—A. Kenneth Graham, H. J. Read
9. BRIGHT, FAST CYANIDE COPPER—C. J. Wernlund
10. GOLD—J. Kushner
11. IRON—C. T. Thomas
12. LEAD—Wm. Blum, A. G. Gray
13. PLATINUM—J. Kushner
14. RHODIUM—J. Kushner
15. SILVER—N. E. Promisel, D. Wood
16. ALKALINE TIN—F. F. Oplinger, F. Bauch
17. ACID TIN—P. R. Pine
18. CYANIDE ZINC—R. O. Hull, C. J. Wernlund
19. ACID ZINC—E. H. Lyons
20. ALLOY PLATING—C. L. Faust

(R. O. Hull, Chairman, Electrodeposition Division)

THE 1942 CONVENTION AT GRAND RAPIDS

The dates of the convention, June 8-11, have been approved by the Executive Board. Mr. Maurice Caldwell, President of Grand Rapids Branch and third vice-president of the National Society writes that Chester Smith has been appointed Convention Chairman. Mr. Smith will shortly announce the names of the various chairmen of committees. These will be published in the August REVIEW.

NEW CHAIRMAN OF RESEARCH COMMITTEE

President Candee announces that he has appointed Mr. Erwin Sohn of the American Radiator and Standard Sanitary Corporation, Louisville, Ky., as Chairman of the Research Committee. Mr. Sohn is familiar with the details of the present program having been a member of last year's committee.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

Waterbury Branch held its last meeting of the season Friday May 9 at the Hotel Elton. Dinner was served in the Colonial Room at 6:30 P.M. to a gathering of twenty-three people. At 8, President Candee opened the meeting, at which there was an attendance of forty. President Candee read a report in which he summarized the work of the year and made suggestions for procedure during the coming year. Vice-President Ralph Colter concurred in the report of the President.

Secretary S. L. Henn reported on the changes made in the membership roll during the year, our final net gain in members being twenty-one. He continued with a summary of the finances of the branch.

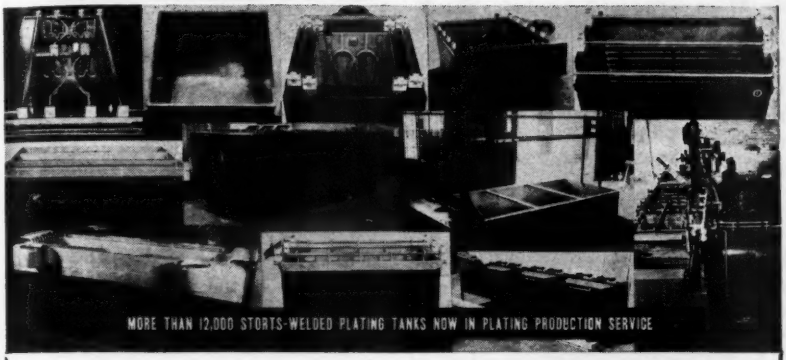
Our librarian E. W. Couch in his report, summarized the educational facilities of the year and sought the earnest cooperation of all members to develop a new and interesting program for the coming year. It is only through knowing the needs and desires of the entire membership that a program having the greatest value can be arranged. The Librarian commented especially on the work of Dr. George Dubpernell, reviewing each month some of the current literature on the subject of plating. He said in part, "It is felt that it is in the interest of all concerned to be familiar with the latest literature available, to help us in our chosen profession. Speaking for the branch, I extend hearty thanks to George for his work in this connection throughout the past fiscal year."

Continuing, he said he especially desired suggestions from the entire membership, for the coming September meeting. The usual practice is to make this meeting social rather than educational in character. New ideas are needed!

Concluding his report, he said, "It is our desire at this time to make acknowledgement to the following individuals and organizations due to their generosity in lending us equipment necessary to the successful carrying on of our program: Bristol Company, Slide Projector; Hotel Elton, Screen for Moving Pictures; Dr. J. M. Freiheit, Sound Motion Picture Projector.

William Gray as chairman of the nominating committee submitted the following names of members for consideration as officers for the coming year: president, Ralph Colter; vice-president, Carl A. Kilborn; secy-treas. Spencer L. Henn; librarian, Earle W. Couch; board of managers, William J. Gray, Tennant Elwin, and George Dubpernell. The officers were elected as suggested by the nominating committee. For the balance of the meeting Ralph Colter, as president, presided.

George Dubpernell reviewed the *Journal* of the Electrodepositors Technical Society, Vol. 16. Although this volume is much smaller due to the war, nevertheless the contributed papers are very valuable, special attention being called to the presidential address on "The Metals." Outstanding is the paper "The Anodic Polishing of Electroplated Nickel" by A. W. Hothersall and R. A. F. Hammond.



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Tennant Elwin, as technical chairman, introduced F. W. Bonacker of the Carborundum Company who told us of the manufacture of artificial abrasives. Mr. Bonacker illustrated his talk with a very interesting moving picture.

SPENCER L. HENN, *Secy.*

Bridgeport Branch held its regular monthly meeting Thursday, June Fifth at 8:00 P.M. at the Stratfield Hotel with President John E. Charleson presiding. Mr. Bert Daw, President of the LaSalco Co. and a member of the St. Louis Branch was a visitor and was introduced to the Branch by President Charleson. Also as visitors to the Branch were our good friends Derick Hartshorn of the Springfield Branch and Jack English of the New Haven Branch.

A motion was made and passed to hold an outing in September. The President appointed Charles McElroy chairman for this affair. The committee will be appointed by the chairman.

A motion was made and passed to hold a meeting at Mr. Axel Boggild's country home July 26, 1941. President Charleson appointed the following men as a committee for this meeting: Axel Boggild, Chairman, Charles McElroy, William A. Ehrencrona, Fred Gotthardt, and David W. Dick. Expenses of $25.00 were allowed the committee for this meeting to be held out doors and Mr. Boggild promised a fine entertainment after the meeting.

Suspension of John Deamico for nonpayment of dues was ordered by the Branch. Mr. Arthur McNeil changed status from associate to active member. Charles McElroy also changed status from associate to active membership.

A purchase of a $500.00 Defense Bond was ordered by the Branch. The secretary was ordered to investigate this purchase beforehand and to register this bond in the name of the American Electroplaters' Society, Bridgeport Branch, and have the bond placed in the custody of the First National Bank and Trust Co., Bridgeport.

The Treasurer's report was read and accepted. President Charleson turned the meeting over to our Librarian, C. C. Helmle who lead a very interesting discussion on the problem of substitution of metals.

JOSEPH G. STERLING, *Secy.*

Montreal Branch held its regular monthly meeting at the Mount Royal Hotel, June 2, which was attended by an increasing number of members. The meeting was called to order by President Jordan. The subject of eligibility of membership to students

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at reduced rates was thoroughly discussed and put to a vote, and carried in favor of admittance for students.

Also the subject of a second vice-president for the Branch was discussed, and a motion was made by J. H. Feeley and seconded by F. R. Lunn for the amendment.

The meeting was then turned over to the librarian, H. Marsh, who read an interesting paper on "Plating to Specifications." The paper covered the initial system of plating, whereby we called for one-half to 1 hour copper and three-quarters hour nickel but had no knowledge of distribution of plate. We then came to the system of plating to .001" and the best method would be the use of a chart, which he submitted, calculating the amperes minutes required to plate said thickness at 100%, 90%, etc. A plater running a few test pieces for one hour and comparing the efficiency of his tanks to the chart, would have some basis to work on.

The paper covered many problems the average plater would come in contact with daily and contained much valuable information.

The librarian then answered questions in the Question Box. The meeting adjourned at 10:45 P.M.

EUGENE FEELEY, *Secy.*

Cincinnati Branch held its regular monthly meeting Thursday, June 26 at the Hotel Alms. Letters were read relating to possession of the Metal Industry Cup. There was some doubt as to whether the cup belonged to the Cincinnati Branch. An article printed in the June, 1940, issue of the *Metal Finishing*, stating that permanent possession of the cup was to be given the branch winning the 1940 exhibits award was shown at the meeting and the secretary was instructed to com-

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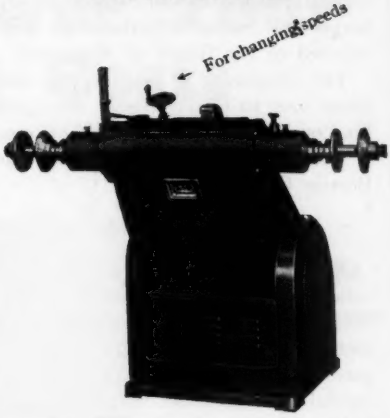

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municate with Mr. Kennedy and Mr. Trumbour and advise them of the article.

The applications of Walter R. Helton, Associate, and Sydney Baumberger for Active Memberships were referred to the Board of Managers.

The remainder of the meeting was given over to Harry Misner who gave his Convention report and told of some of his personal experiences at the Boston Convention.

MARTIN GANNON, JS, *Secy.*

Toledo Branch June meeting was called to order by the new President, Mr. Vannersdall at 8 o'clock. A motion by Mr. Shank that the delegates to the convention should, after careful consideration, use their own judgment, in voting on any measure to come before the convention, in the interest of the branch, and the society as a whole, was passed. A motion by Mr. Wieker that the branch pay the secretary's expense to the convention was passed by a unanimous vote. The secretary was instructed to act as spokesman, and to vote for the delegation.

Paul Dressell was appointed as chairman of the educational committee, and the Vice-President, Mr. Shank, of the membership committee. It was left up to the educational chairman to decide which meetings would be held at the school, and which ones would be held at the Hilcrest Hotel.

The membership of the Toledo branch gave a party on Monday night June 30 at the Hilcrest Hotel in honor of two friends, and highly respected members, Mr. Philip Hale, and Mr. Harry E. Moser, who are going to leave Toledo in the near future, Mr. Hale to retire on his farm in Indiana, and Mr. Moser to accept a better position in Detroit. Dinner was served at the Hotel at 6:30 for 15 members. After dinner, refreshments were served, card tables were set up, and the rest of the evening was spent in playing cards, chatting, talking over old times, etc. Toledo branch regrets losing two if its best friends and members. But from the bottom of our hearts we wish these two swell fellows the best of luck in their future plans. We sincerely hope they will find time to visit us occasionally, and that their memories of the Toledo boys will be pleasant ones.

The next regular meeting of the branch will be held the first Thursday in September.

G. H. BERGEMAN, *Secy.*

Chicago Branch held its regular monthly meeting at the Atlantic Hotel Saturday, July 12, 1941. President

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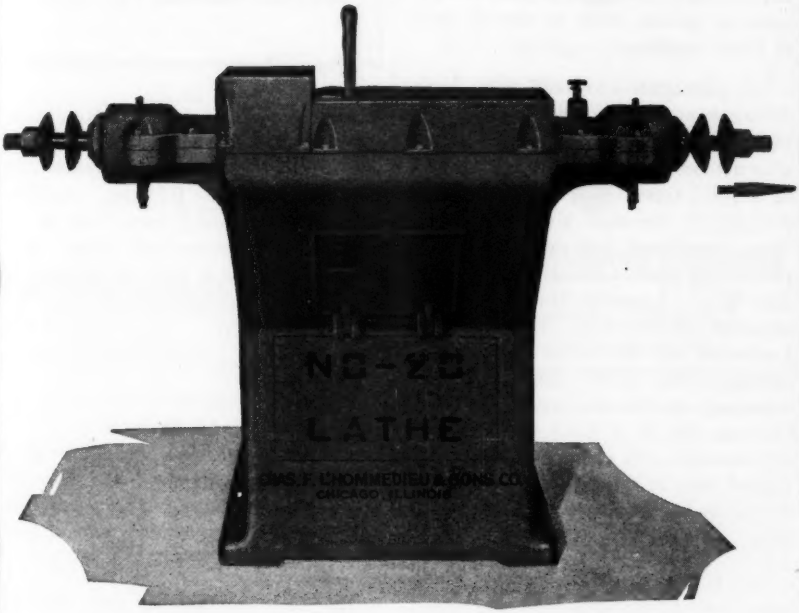

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C. Kelly presiding and all other officers present.

The Electrochemical Society will hold their convention in Chicago at the Knickerbocker Hotel on Oct. 1, 2, 3, 4. All members of the Chicago branch were invited to attend and as there will be several papers on plating it is hoped that as many members as possible will make a special effort to attend each of these sessions.

An invitation was read from both Milwaukee and Detroit branches to their annual Picnic and all members who attend either or both are assured of a good time. The applications of Mr. K. D. Overholt and Mr. R. E. Olson were read and committees appointed on same. Mr. J. A. Gorz and Mr. W. L. Lopatka were elected to associate membership. Mr. James C. Lockerbie was elected to active membership. Mr. Kelly appointed the following membership committee for this year: Mr. E. A. Lanz, C. Clindinin, H. Smallman, R. Hazucha, and E. G. Coffey, they in turn urge each member do his bit by helping secure new members.

Mr. E. Woodmansee, our librarian, introduced a very well-known member of Chicago branch, Mr. C. Kocour, as the speaker for this evening. Mr. Kocour gave a very interesting talk and demonstrated the Crane Co's new Chromium Plate Thickness Tester and a new Quinhydrone P.H. set. As both these sets are new a great deal of interest was displayed in them. Mr. Kocour received a vote of thanks for keeping us informed on these up to date methods.

J. W. HANLON, *Secy.*

PLATER WANTED

A man to work on cadmium, nickel, copper, and chrome solutions. Owner is a member of the A.E.S. Write to QUICK CHARGE, INC., 1750 N. E. 10th St., Oklahoma City, Okla.

Chicago Branch

1. *What is the best method for preparing high carbon taps and reamers before chrome plating, reverse current will not work as it leaves a carbon film that will not plate over?*

Ans. It was thought that the reverse current was used too long and too high. Try lower current and shorter

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time. It was also suggested that a slight etch in a nitric acid dip would help.

2. *What causes cloud effect on cadmium plated steel parts after chrome acid dip?*

Ans. The gray cloud is caused by too much chrome acid in the dip, and the brown color by too low an acid content, also too many impurities in the solution such as copper will cause.

3. *In an alkaline zinc bath when insoluble anodes (steel) are used the throwing power decreases. How can this be overcome?*

Ans. By lowering the zinc content or by raising the cyanide, or by adding 3 or 4 ozs. Rochelle salts per gal.

4. *What is a good brightening agent for a cyanide zinc bath?*

Ans. Mercury oxide, or sodium chromate.

5. *Would like to know how* 18 - 8% *stainless steel is plated in chrome to prevent discoloration when exposed to heat.*

Ans. If the stainless steel is colored good with a high luster same can be plated direct in chrome or it can be cleaned, acid dipped and plated, or use reverse current for a few seconds with a double throw switch on the chrome bath. J. W. HANLON, *Secy.*

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The Abstract Section

CHARLES C. CONLEY, *Chairman, Program and Educational Committee*

Disposal of Waste Liquors from Chromium Plating. By C. R. HOOVER and J. W. MASSELLI of Wesleyan University, Middletown, Conn. Taken from *Industrial and Engineering Chemistry* of **January,** 1941, pages 131 to 134 incl. When metallurgical wastes containing chromium are discharged to sewers or open streams, objectionable conditions are produced and a relatively valuable metal, of which we have only a limited national supply, is lost. In this investigation, waste solutions from chromium plating are the special subject of study. Two methods for preventing harmful effects in streams are suggested. One uses scrap steel to reduce the chromium to the trivalent condition and also lime as a neutralization and precipitation agent; the other employs barium sulphide as a combined reducing and precipitating reagent and also lime for the completion of neutralization and precipitation.

The most feasible recovery process appears to involve the use of sulphur dioxide as a reducing agent and soda ash for precipitation. The filtered precipitate is roasted to produce chromium trioxide in soluble form.

The conclusions drawn were, "that one or two processes offer promise of being able to recover enough of value in the form of byproducts to pay all the direct operating cost," but that no treatment process now in sight will be able to recover sufficient values to pay the entire cost of treatment.

ROBERT B. GOODSELL.

Current Distribution and Throwing Power in Electrolytes. By A. V. ENGEL. *Nature* **146,** 66 (1940); *Chemical Abstracts* **34,** 6529 (1940). Using a two cathode arrangement in acid copper solutions, it was shown that the ratio of the current densities on the main and secondary cathodes decreased with increasing distance between the cathodes and with increasing current to the main cathode, especially at small spacings. The ratio was independent of the distance from the anode over a wide range.

ERNEST H. LYONS, JR.

Temperature Rise of Bus Bars. By H. B. DWIGHT, G. W. ANDREW and H. W. TILESTON, JR. *Gen. Electric Review* **43,** 213-16 (1940). Calculated and test results for single and built-up bar forms; also solid and tubular round, and square tubular forms are considered and examples given.

COLIN G. FINK

Chemical Abstracts **34,** 6170 (1940)

Rapid Nickel-plating of Printer's Type. By A. I. NEVSOROV. *Poligraf. Proizvodstvo* **1938,** No. 5, 20-1; *Chem. Zentr.* **1938, II,** 3314. A bath containing 250 g. $NiSO_4$, 20 g. NaCl, 20 g. H_3BO_3 to 1 liter water is recommended. The current density should be 5 amp./sq. dm. (46.5 amp./sq. ft.), the temp. 40-5° C. (104-113° F.), pH 5, the spacing between the electrodes 10 cm. (4″). The advantages of the process are discussed.

M. G. MOORE

Chemical Abstracts **34,** 6170 (1940)

FILTERS for

- ***Bright Nickel***
- ***Nickel***
- ***Chrome***
- ***Copper Sulphate***
- ***Brass***
- ***Cyanide Copper***
- ***Brite Zinc***
- ***Silver***
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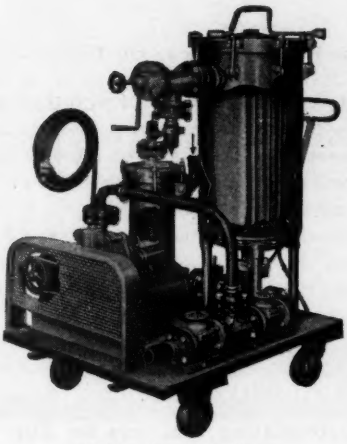

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The Iron Content in the Chromium-Plating Bath and Its Precipitation. By W. ALBERTH. *Z. Metall- u. Schmuckwaren- Fabr. Verchrom.* **19,** No. 5, 11-12 (1938); *Chem. Zentr.* **1938, II,** 2837-8. Contamination of the bath, especially by iron, causes great difficulty in chromium plating. A method of precipitating the iron with chromic hydroxide, $Cr(OH)_3$, is described which is satisfactory in practice and which does not greatly change the composition of the bath.

M. G. MOORE

Chemical Abstracts **34,** 6527 (1940)

The Iron Content in the Chromium-Plating Bath and Its Precipitation. By W. ECKARDT. *Z. Metall- u. Schmuckwaren- Fabr. Verchrom.* **19,** No. 6, 15 (1938); *Chem. Zentr.* **1938, II,** 2838; cf. preceding abstract. The iron which enters the bath largely as an impurity in the chromic acid (the commercial acid contains about 0.05% iron) reaches an objectionable concentration only after one year's continuous operation of the bath. At a concentration of about 7 g. iron per liter white spots (not iridescent blue ones) are observed on the chromium plate. When these occur the addition of 3 g./1. sodium fluoride or ammonium fluoride is recommended. The fluoride ion renders the iron harmless up to 20 g. iron per liter. Then the iron must be precipitated and the solution filtered, since otherwise the iron precipitate will go back into solution during subsequent operation of the bath.

M. G. MOORE

Chemical Abstracts **34,** 6528 (1940)

Electroplating Practices for Zinc Die-castings. By E. E. HALLS. *Metal Treatment* **6,** 39-44; *Foundry Trade J.* **62,** 449-51 (1940). A compilation.

F. G. NORRIS

Chemical Abstracts **34,** 6528 (1940)

Barrel Finishing of Metal Products. H. LEROY BEAVER. *Products Finishing,* September 1940, p. 20. Author discusses barrel liners and interior burnishing barrel design. Various interior designs for mixing or stirring up the work during burnishing are discussed, such as tapered liners, fluted side plates, bone-shaped end plates and "saw-tooth" liners. Author concludes from study that anything which interferes with flow of burnishing material in the barrel is detrimental to good results and hence is not advised.

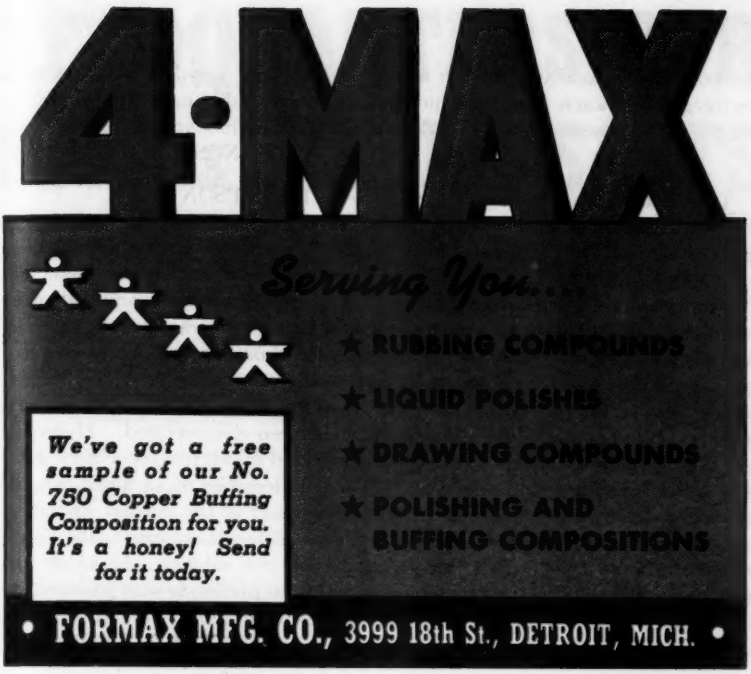
PHIL J. RITZENTHALER

The Determination of Density of Electrolytic Baths. By A. WOGRINZ. *Oberflachentech.* **17,** 67-8 (1940). The density of an electrolytic bath and its change during operation are of special importance in acid baths. In the acid zinc bath the usual hydrometer method is not accurate. The use of the Mohr-Westphal balance is recommended for these density determinations which gives results of 0.05% accuracy, much more than required for practical purposes, and which is yet simple to use.

M. HARTENHEIM

Chemical Abstracts **34,** 5352 (1940)

The Reaction Between Iron and Water in the Absence of Oxygen. By M. deKAY THOMPSON. *Trans. Electrochemical Society* **78** (Preprint 24) (1940). It has been questioned whether iron will corrode in pure water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without the attack of dissolved oxygen. Pure iron powder left for a week in oxygen-free water through which hydrogen was bubbling corroded to form magnetic iron oxide, Fe_3O_4, in accordance with thermodynamic theory.

ERNEST H. LYONS, JR.

The Hydrogen Anode. By M. deKAY THOMPSON and H. V. FAIRBANKS. *Trans. Electrochemical Society* **78** (Preprint 23) (1940). It is suggested that a hydrogen anode would make it possible to maintain a constant composition in certain plating solutions, such as brass, where the anode efficiency exceeds the cathode efficiency. The hydrogen anode would dissolve hydrogen in the solution at the same rate at which it is liberated at the cathode, and the building up of the metal content with accompanying decrease in free cyanide, along with the increase in pH would be avoided. Moreover the anode would have theoretical interest. A hydrogen anode was devised using a porous carbon tube on which platinum had been electroplated. Hydrogen gas flowed through the tube, which was immersed in dilute hydrochloric acid. The anode efficiency was 100% up to current densities of 14 amps./sq. ft.; at higher densities it fell as low as 50%, with part of the current liberating chlorine from the acid. In nickel and copper chloride solutions, the anode efficiencies were lower. After use in copper cyanide solution, the anode had zero current efficiency in 0.1 *N* HCl, because the platinum was poisoned by the cyanide. Its activity was restored by heating at 1200°F. for three hours.

ERNEST H. LYONS, JR.

The Electrolytic Polishing of Stainless Steels. By H. H. UHLIG. *Trans. Electrochemical Society* **78** (Preprint 25) (1940). The anodic "pickle polishing" of steel was studied with a photoelectric spectrophotometer which gave accurate measurements of the degree of polish. The best surfaces on 18-8 stainless steel were obtained in a bath of 42% phosphoric acid (sp. gr. 1.7), 50% glycerine (sp. gr. 1.25) and 8% water by weight. The temperature was 212° F. or higher, voltage 2.5-4.0, and the current density 15 amps./sq. ft. or higher. 15 minutes were required at 72 amps./sq. ft. From 0.00025-0.0005″ of metal were removed, the most metal being removed at the lower current densities, where the current efficiency in removing metal was 30%. No data are given as to the life of the bath. Chrome steels and mild steels can be polished in the same solution, but lower temperatures are better. Nickel and copper steels, and 18-8 stainless containing molybdenum were also polished. Steel and iron are more difficult to polish than 18-8 stainless, because varying heat treatments and carbon contents alter the conditions for producing best results. For mild steel, a mixture of equal volumes of carbitol and phosphoric acid is recommended, at a temperature of 122-176° F., with a current density of 72-144 amps./sq. ft. for 15 minutes or more. Glycerine can be replaced by such substances as ethylene glycol, carbitol, methyl cellosolve, or acetic acid. Glycerine prevents pickling by chemical action and eliminates pitting. Curves are shown for effect of composition, temperature, and c.d., and the mechanism of polishing is discussed. It is believed that the anodic corrosion products form a viscous, poorly conducting film which slows down the action in the low portions of the surface but exposes the high parts to attack.

ERNEST H. LYONS, JR.

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The Cause of the Greater Covering Power of Metals Deposited from Solutions of Complex Salts. By A. GLAZUNOV. *Chem -Listy.* **34,** 2-4 (1940). The discharge of the simple ions of metals on the cathode occurred in many scattered points on the surface; the number of points and their rate of growth determined the covering power of this group of metals (silver, copper, brass). The discharge of complex ions of metals was a secondary process, the metal precipitating (after being discharged) in the form of individual atoms on the entire surface of the cathode and forming a mirror surface. Colloids which envelop the cation and travel by cataphoresis to the cathode prevented the growth of crystals and increased the number of points of crystallization on the surface; the discharge approached that of simple metallic ions. The discharge of colloidal substances, combined chemically with the metal, resembled the discharge of complex ions. Since the precipitation of the metal was a secondary process the precipitate could not be made finer (by an increase in the number of crystallization centers or by a decrease in size of the deposited particles) by the presence of colloids.

FRANK MARESH

Chemical Abstracts **34,** 5341 (1940)

Testing Electroplates. By JOSEF TEINDL. *Hornicky Vestnik* **19,** 410-414 (1937); *Chem. Zentr.* **1938, II,** 2346. A review covering the causes of corrosion of tin and steel, the influence of the alloy $FeSn_2$, and methods for testing the thickness and porosity of tin plates.

M. G. MOORE

Chemical Abstracts **34,** 5342 (1940)

Addition Agents in the Electrodeposition of Zinc. By J. L. BRAY and F. R. MORRAL. *Trans. Electrochemical Soc.* **78** (Preprint 15) (1940). The effects of 29 organic substances (mostly amines) on the smoothness and ductility of electrodeposited zinc are reported. The cathodes were steel wire, and the solution was saturated zinc sulfate 0.1 *N* in sulfuric acid. Lead anodes were used. The cathodic current density was 500 amps./sq. ft. for 6 minutes, giving deposits of 2 oz./sq. ft. (.004″). It was concluded that it is the actual amount of nitrogen in the amine which determines the ductility and appearance of the deposit. Less than 0.00006 g./1. of nitrogen are needed. The effect of the organic radicals was studied. Wetting power and complex salt formation are not important factors. Good results were obtained from such compounds as diamyl amine, diamyl aniline, monobutyl amine, n-butyl naphthylamine, tributyl amine, triethanolamine, and trimethyl amine.

ERNEST H. LYONS, JR

Electroplating with Three Electrodes. Bright Zinc and Cadmium. By J. GUZMÁN and L. QUINTERO. *Anales soc. españ. fís. quím* [5], **35,** 24-40 (1940?). The Guzmán method (*Ibid.* **32,** 918 [1934]) of potential indicator is applied to electrodeposition with the possibility of foregoing observations of current density. This method is used to produce bright deposits of zinc and cadmium from cyanide solutions containing a colloid and a little nickel. To produce a brilliant zinc deposit, an indicator potential of 16

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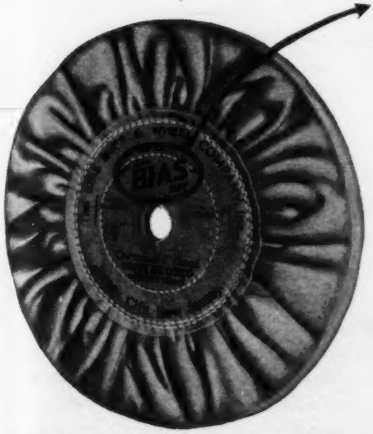

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microamps. is required, corresponding to 410 mv., and for cadmium 20 microamps. and 520 mv., in both cases using a soluble anode and no stirring.

E. M. SYMMES

Chemical Abstracts **34,** 5351 (1940)

Electrodeposition of Zinc in the Presence of Organic Addition Agents. By C. H. SENTER and ROBERT TAFT. *Trans. Kansas Acad. Sci.* **42,** 237-40 (1939); *Chemical Abstra ts* **34,** 5351 (1940). Of 25 addition agents, lactic, citric, and benzoic acids, phenol, ethyl carbamate, B-naphthol, p-hydroxyphenylglycine, and p-hydroxybenzoic acid produced deposits from an acid zinc bath distinctly smoother and whiter than those from a standard acid bath. Only B-napthol gave superior results in the alkaline bath. With lactic acid and $ZnSO_4$ from 0.1-6.0 *N*, the current efficiency varied from 60.5 to 96.3% at 86° F., with poorer deposits at the lower concentrations. Phenol, B-naphthol, and p-hydroxybenzoic acid permitted a current efficiency of 100% in acid baths; B-naphthol gave an efficiency of99.8% in an alkaline bath. The adsorption of addition agents by the metal many times plays an important part in determining the character of the deposit and the apparent current efficiency. Sugar as an addition agent gave apparent current efficiencies ranging from 105-643% for concentrations from 0.1-2.0 N; these deposits were non-adherent and discolored. ERNEST H. LYONS, JR.

Electrodeposition of Chromium from Potassium Dichromate Baths. II. In the Presence of Sulfate and Acetate. By S. R. PATHAK and S. HUSAIN. *J. Osmania Univ.* **6,** 9-18 (1938). Deposition from 0.5 *M* $K_2Cr_2O_7$ is uniform, black and adherent. The addition of small quantities of H_2SO_4 results in the production of bright, white adherent deposits of chromium with current efficiency of 9.44%. Satisfactory deposits are also obtained if $KHSO_4$ is used instead of H_2SO_4, but the current efficiency decreases to 6.54%. No deposit is obtained if K_2SO_4 is used instead of H_2SO_4. When acetic acid is added to baths containing $K_2Cr_2O_7$, bright white deposits of chromium are produced. An electrolyte containing 0.5 *M* $K_2Cr_2O_7$ + 0.5 *M* HAc at a c.d. of 0.05-0.25 amp./cm.^{2} (46-230 amp./sq. ft.) yields a current efficiency of 14.29%. Hardly any deposit is obtained if sodium acetate is used instead of acetic acid. Therefore, it seems the presence of hydrogen ion is essential for the deposition of chromium. **III. In the Presence of Borate.** By M. ASAD ALI and S. HUSAIN. *Ibid.* 19-27. $K_2Cr_2O_7$ baths, containing relatively high concentrations of boric acid, yield bright, white, uniform deposits of chromium. With a current density of 0.025 amps./sq. cm. (23 amps./sq. ft.) at 40° C. (104°F.), the current efficiency was only 1% under the best conditions. Baths containing borates instead of boric acid produce no deposits on electrolysis. Lead anodes produce the same results as platinum anodes. Experiments of the influence of distance between the electrodes on the electrodeposition of chromium showed that when the electrodes were 8 cm. (3.2 in.) apart, the best results were obtained in the above experiments. Varying this distance produced a very noticeable effect on the chromium deposits. L. H. SEABRIGHT

Chemical Abstracts **34,** 5350 (1940)

Electrodeposition of Some Metals from Solutions of their Sul-

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famates. By HAROLD S. CHOGUILL. *Trans. Kansas Acad. Sci.* **42,** 213 (1939). Copper deposition from 0.5 *M* solution of copper sulfamate at a current density of 0.1 amp./sq. dm. (0.9 amp./sq. ft.) gave an uneven and crystalline deposit. At current densities up to 5 amp./sq. dm. (46 amps./sq. ft.) the copper deposits were firm, smooth, lustrous and coherent. 0.5 *M* solutions of copper sulfamate with 0.03-0.3 *M* sulfamic acid gave lustrous and coherent deposits up to a current density of 5 amps./sq. dm. (46 amps./sq. ft.). The addition of ethyl alcohol to the plating baths yielded erratic results. Increase in temperature generally improved the deposits. With copper cathodes and platinum anodes, cadmium sulfamate gave firm, even, smooth deposits which took a high polish. Zinc sulfamate gave smooth, gray, firm deposits on copper cathodes when platinum anodes were used at a current density of 3 amp./sq. dm. (28 amp./sq. ft.). Nickel sulfamate failed to give bright deposits on copper or nickel cathodes at any current density, temperature, or concentration investigated.

H. E. MESSMORE

Chemical Abstracts **34,** 5351 (1940)

Electrolytic Polishing of some Alloys containing Nickel and Chromium. By P. A. JACQUET. *Metaux & Corrosion* **14,** 127-31 (1939). Stainless steel and Inconel were polished with a solution containing perchloric acid of density 55° Baume and acetic anhydride. The sample to be polished is made the anode and aluminum is the cathode. The density of the current should be between 5 and 8 amp. square dm.

G. T. MOTOK

Chemical Abstracts **34,** 3187 (1940)

Electrochemical Potential Differences at the Boundary of Copper-Insulating Liquids. By ANDREW GEMANT. *Trans. Electrochemical Society* **78,** (Preprint 21) (1940). A study of the electrochemistry of copper salts in insulating liquids, such as mixtures of kerosene, benzol, alcohol, gasoline, xylene, etc. The copper salts were copper oleate and copper acetate. Of interest to electroplaters as an extension of electrolytic theory to non-aqueous liquids and a new method of attack on corrosion in insulating liquids.

ERNEST H. LYONS, JR.

Outdoor Exposure Tests of Electroplated Nickel and Chromium Coatings on Steel and Non-Ferrous Metals. By WILLIAM BLUM, and P. W. C. STRAUSSER. *J. Res. Natl. Bur. Standards* **24,** 443-74 (1940) (Research Paper No. 1293). Electroplated samples were exposed to the atmosphere at six locations. Results are presented for tests started since 1936. Basis metals employed were (1) steels, (2) zinc and die castings, and (3) copper and brass. Bright nickel on all three (1938 baths) showed a tendency to crack, although some coats were superior. Variation of plating procedure for nickel on copper and brass did not affect the atmospheric resistance. For equal protection the nickel coat for steel should be 0.00085″, for zinc die castings 0.0007″, and for copper and brass 0.0002″ thick. Copper under nickel on steel and die castings does not give the same protection as the same thickness of nickel. A chromium coat thicker than 0.00002″ over nickel on steel gives increased protection, but for copper and brass the chromium should be less than 0.00005″ thick. Chromium plated directly on die castings, copper,

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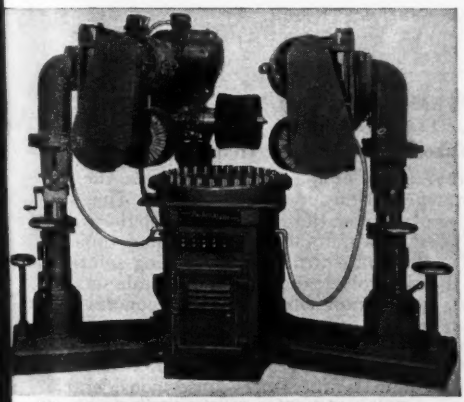

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or brass gives little atmospheric resistance; a nickel coat under the chromium is necessary. F. W. FINK

Chemical Abstracts **34,** 5761 (1940)

Electrochemical Applications in the Wire Industry. By C. L. MANTELL. *Wire and Wire Products* **15,** 578-81 (1940). A review of the anodizing of aluminum; electrolytic coloring of copper, zinc, and galvanized wire; electroplating of wire; electrogalvanizing by the Tainton process; and electrodeposition of rubber and resinous lacquers. Patent references are given. ERNEST H. LYONS, JR.

The Technique of Anodic Oxidation of Aluminum with Special Consideration of the Alumilite Process. By JOHANN WALTER, JR. *Aluminum-Arch.* **1,** 9-99; *Chem-zentr.* **1938, II,** 3740-1; *Chemical Abstracts* **34,** 6173 (1940). Pure German aluminum (99.4% semihard) was cleaned 5 minutes in 10% NaOH at room temperature, and anodized for 5 minutes in dilute sulfuric acid. D. c. gave a dull, silvery appearance; a.c. produced slightly yellowish coatings. Resistance to abrasion of the coatings decreased with acid stronger than 10% or with longer treatment and higher temperatures. Harder films were obtained with d.c. than with a.c. The insulating value (dielectric strength) increased with the amount of current used. Coatings produced at 60° C. (140° F.) showed no measurable dielectric values. All coatings produced above 40° C. (104° F.) showed marked local corrosion in the salt spray. D.c. gave better corrosion resistance than a.c. Films produced in dilute HCl and other electrolytes, and on aluminum alloys are discussed. The power of adsorbing dyes was independent of the concentration of the electrolyte but did depend on the current density, the duration of the electrolysis, and the pH of the dye solution. Results with several dyes are reported. ERNEST H. LYONS, JR.

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The Brown Instrument Company, Philadelphia, Pa., announces the development of a new system of instrumentation for plating tanks. This system fundamentally involves direct control over the temperature of the water which is circulated through pipe coils or water jacket rather than indirect control of the circulating water from the temperature of the plating solution.

According to the manufacturer, the electrolytic deposition of metals such as chromium, copper, nickel, cadmium, etc., is more effectively and economically accomplished if the plating solution or bath is maintained at a temperature consistent with the desired conductivity or "throwing power" of the solution. Depending upon the materials being used and the results desired, variations of only a few degrees from the optimum temperature cause considerable changes in the lustre and color of the finish and in the density and depth of the plate.

The manufacturer further states that this new system offers the following advantages: Maintains a uniform plating temperature; Saves on amount of steam and cold water necessary; Longer life obtained from the control thermometer because bulb is not subjected to a destructive action of the plating solution; Cheaper bulb construction suitable; Not necessary to sacrifice valuable space in plating tank for installation of bulb; Not necessary to electrically insulate bulb and connecting tubing from sides of tank, hence no danger of bulb failures from electrolysis.

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IRON OUT

(Reprinted from Colliers, week of July 5, 1941)

Upstairs from the plastics lab Drs. G. H. Nelson, chemist, and Robert Straka, bacteriologist, cut out another project. At the outset they decided it would be nice if they could find bacteria, molds or fungi which would eat away unwanted materials in stalks and straws and leave pure cellulose for paper-making. Following their microscopic hounds, they went far afield of the project originally outlined.

Lignin, which accounts for about 25 per cent of all pulpy vegetable matter, offered greatest difficulties. No microbes would touch it. Nelson, who hadn't the slightest idea about why they turned up noses at this food, started out on a long-range study of the substance. Very little is known of the chemistry of lignin beyond the fact that it appears to be the glue that binds cellulose together to make trees, cornstalks, hollyhocks and other such vegetable matter.

Wanting to see how it reacted with various metals, he stirred pure lignin into a solution which contained some of the common salts of iron. When he filtered the solution, the filter paper was covered with a blackish substance! Lignin had precipitated about 98 percent of the iron out of the solution. Realize the role iron plays in water and you'll catch the significance of this happening. Iron, which imparts an evil taste and color to water, is disastrous to textile, paper, ice and laundry industries. It discolors bath fixtures, clogs pipes and is otherwise an expensive nuisance in municipal water systems. Next to the suppression of bacteria, it offers the biggest problem in the life of any water company.

Thousands of tons of the mineral zeolite, lime, soda ash and other iron removers are used annually in the United States. From advance data so far available, lignin does the job more cheaply and more efficiently than any of these materials. Lignin can be extracted from corncobs, stalk and straw, and is also available in paper-mill wastes. At present it has only two uses. Since it extracts moisture from the air it is utilized to a small extent to keep down dust on country roads. A minute amount goes to make synthetic vanilla extract. Nelson's work opens up an enormous new outlet.

While Nelson was making this discovery Dr. Straka kept at the problem of fermentation. Scores of jars containing a grim-looking black mash made of cornstalks and other debris bubbled away. When no cultures were found that wanted to eat lignin, Straka began to analyze gases given off by fermentation. Most of the bottles were giving off hydrogen, a small amount of carbon dioxide and a large amount of methane—inflammable marsh gas. An idea struck. Why couldn't farmers use waste straw and cornstalk to manufacture their own fuel gas? Use it in their cookstoves and light their homes with it?

Straka weighed bottle charges of chopped stalk, and metered the gas produced. Resulting figures indicated that a ton of fodder would produce 10,000 cubic feet of gas. Since domestic consumers of manufactured gas pay an average of $1.18 a thousand for this fuel, Straka's fodder has an indicated gas value of $11.80 a ton.

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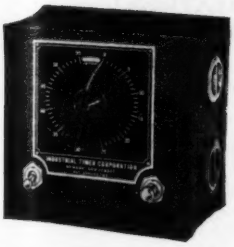

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SAVES TIME AND MONEY
ALL ELECTRIC TIMER

Set timer for required length of plating process . . . At expiration of timing period, signal goes off . . . You can equip this timer with additional buzzers, gongs or signal lights . . . Automatic reset for identical repeat operations—just push the button. For additional data, write for ***Bulletin A-17.***

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Acid-proof Lining for Pickling Tanks, Pits, Drains, Floors, Basins, Foundations.

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Acid-proof Mortar for Bonding Brick and Tile. Sets by Chemical Action.

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A 100% Bakelite Coating. Unequalled for protection of Bonderizing or Processing Tanks. Lengthens the life of any surface—Wood, Metal, Cement, Brick, Composition, Linoleum, Stone, Rubber, Concrete, Canvas.

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PERMAG points the way to eliminate your cleaning difficulties and cut cleaning costs to a low minimum.

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LYE BURNS HEALED IN NEW TREATMENT

Success in treatment of lye burns with hydrosulphosol in the first case of of its type in the United States has been disclosed in a report of the Good Samaritan Hospital staff of Phoenix. The physicians said the record kept of the treatment may serve to establish the safety of hydrosulphosol for use about the eyes, nose and mouth.

The patient was Pat Gibbons, aged 48, captain of the Arizona State Prison guard. A prisoner dashed a quart jar of commercial lye full into Gibbon's face. The lye solution entered Gibbons's nose and mouth, burned his eyes, tongue, neck and both ears. The lids and ball of each eye were burned severely. Physicians sprayed the burned areas thoroughly with hydrosulphosol solution every hour during the first twenty-four hours.

Gibbons has regained the full sight of his left eye and treatment for his right eye is being continued. Most of his face has healed "surprisingly free of scars," the physicians reported. Except for one patch over his left eye, his appearance is normal. Growth of new cells is stimulated by the drug, which lays down a thin, pliable coating over the burned areas. This reduces the pain because it excludes oxygen from the burned areas and speeds up the healing process.

Dr. A. E. Cruthirds of Phoenix learned of the drug from Dr. Ralph R. Mellon, medical director of the Institute of Pathology at Pittsburgh, who visited the Arizona city recently. Use of hydrosulphosol solution was developed after three years of research at the Institute of Pathology, Western Pennsylvania Hospital, Pittsburgh. Dr. Wilmot F. Pierce, chief surgeon at Golden State Hospital, Los Angeles, developed use of the solution for treatment of burns. But this was the first case in which it was applied to lye burns.

NORTON COMPANY APPOINTS

Norton Company, Worcester, Massachusetts, manufacturers of grinding machines, grinding wheels and other abrasive products, has announced the appointment of Paul Fielden director of purchases. Mr. Fielden has been connected with the company 21 years as assistant credit manager and credit manager. He has been prominent in local and national credit men's associations and in 1937-1938 was president of the National Association of Credit Men.

John Miller, for a number of years assistant credit manager of Norton Company, succeeds Mr. Fielden as credit manager.

Marcus W. White retains the position of purchasing agent, which he has held with the company for many years.

NEW ANODE SCRAP BASKETS

The new Hanson-Van Winkle-Munning rubber covered scrap anode basket is furnished with two hooks, allowing the basket to be hung on anode rods in still tanks and plating barrel tanks. A new anode is inserted in the basket and hung on the anode bar. The anode stubs are placed in the basket around the new anode allowing this metal to be used.

The basket, made of steel wire with proper reinforcements at the top, at all ends, and at the bottom, can be used in solutions where temperature does not exceed 180 to 190 deg. F. (Almost all plating solutions are operated below this temperature.)

The hook for the scrap anode baskets can be furnished 4" or 5" long as desired, and the baskets can be made to dimensions specified. The inside measurements of standard sizes are 9" long x 18" deep x 4" wide, 12" long x 24" deep x 4" wide, 16" long x 30" deep x 4" wide, and 20" long x 40" deep x 4" wide, the outside width being approximately 1" additional. The Hanson-Van Winkle-Munning Company is also in a position to furnish anode bags for these baskets.

adsorb

THE LITTLE LETTER THAT MEANS A LOT

. . . in cleaning electroplating solutions

Everyone knows what "absorb" means. "Adsorb" is less familiar. But the more a plater learns about adsorption — through the purifying action of Darco* S-51 on electroplating solutions — the better he likes the idea.

By adsorption, Darco S-51 removes the "ghosts" that so often spoil a plating job. It takes out oil, grease, soap, colloidal impurities, decomposition products, and other "spooks." It leads the way to better, brighter work.

Darco S-51 is the activated carbon made specifically for electroplating solutions. It wets easily . . . acts quickly . . . costs little. Get a supply from your jobber — or send us a post-card for a liberal sample.

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60 East 42nd Street
New York, N. Y.

Membership Report

MAURICE R. CALDWELL, *Chairman, Membership Committee*

To July 1, 1941

ELECTIONS

Buffalo Branch

Albert M. Krauszer, % Y.M.C.A., Barry Street, Olean, N. Y. Associate

Chicago Branch

J. A. Garz, 2731 North Artesian Ave., Chicago, Ill. Associate
J. C. Lockerbie, % Standard Plating Co., Goshen, Ind. Active
W. L. Lopatka, 1039 North Wood Street, Chicago, Ill. Associate

Philadelphia Branch

Herman J. Hackenburg, 8437 High School Road, Elkins Park, Pa. Active
Hermann Maak, Pottstown Plating Works, Washington & Laurel Sts.,Pottstown, Pa. Active

APPLICATIONS

Cincinnati Branch

Sidney Baumberger, 3637 Ravenwood Ave., Cincinnati, Ohio. Active
Walter Royden Helton, 149 Hueston St., Hamilton, Ohio. Associate

SUSPENSION

M. F. Ehrler, Chicago Branch

RESIGNATIONS

W. M. Vande Bogart, Chicago Branch
Philip Hale, Toledo Branch

DEATHS

G. W. Gilson, 3416 Park Ave., Kansas City, Mo. Chicago Branch
E. Bernhardt, 6606 South Francisco, Chicago, Ill. Chicago Branch

Remember Newark Branch

ANNUAL FISHING TRIP

Saturday, August 9, 1941

at Watertown, N. J.

and Don't Forget Our

ANNUAL PICNIC

on

Saturday, September 6, 1941

at Vogel's Grove, Union, N. J.